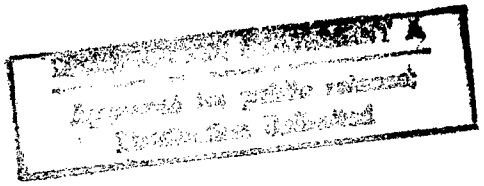
JPRS-CEA-85-056

26 June 1985



China Report

ECONOMIC AFFAIRS

ENERGY: STATUS AND DEVELOPMENT--39

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

JPRS-CEA-85-056

26 June 1985

CHINA REPORT

ECONOMIC AFFAIRS

ENERGY: STATUS AND DEVELOPMENT--39

CONTENTS

PEOPLE'S REPUBLIC OF CHINA

NATIONAL POLICY

NORTHWEST DEVELOPING OIL, COAL, HYDROPOWER RESOURCES

OW080811 Beijing XINHUA in English 0724 GMT 8 May 85

[Text] Xining, 8 May (XINHUA)--China's longest high-voltage d.c. power transmission line will begin carrying electricity from the northwestern China power grid to northern China in 1988.

The 1,300-km line will than greatly ease power shortages in industrial areas of Beijing and Tianjin, said Shi Ruifang, director of the northwest China power design institute of the Ministry of Water Resources and Electric Power.

It will run from the Qinghai provincial capital of Xining to the Hebei provincial capital of Shijiazhuang.

This is part of the northwestern region's efforts to develop its rich energy resources in order to boost supplies to other parts of the country, Shi said. The region refers to Shaanxi, Gansu, and Qinghai provinces, and the Xinjiang and Ningxia autonomous regions.

Hydropower potential there is estimated at 50 million kW next only to that in southwestern China.

A total of 223 hydroelectric power stations with a generating capacity of over 10,000 kW can be built on the [Huang He] and two other major waterways in the region, Shi said.

Four large hydroelectric power stations now operate on the upper reaches of the [Huang He] producing 10 billion kWh of electricity a year.

The 1.38-million kW Longyangxia station, also on the [Huang He] will transmit most of its power output to north China when it goes on stream in 1988, Shi said.

Another 15 large stations are also to be built on the river, he said, with a combined generating capacity of nearly 12.5 million kW; they will generate 50 billion kWh of electricity annually.

The region's coal reserves are verified at 140 billion tons, second only to those in northern China, said the director, who attended a recent meeting on the region's energy development.

New coal mines will be built in Shaanxi, Ningxia, and Qinghai over the next few years to increase supplies to the coal-deficient southwestern and central areas, Shi said.

Moreover, there are five large oilfields in Xinjiang, Gansu, and Qinghai, with sizable reserves of petroleum and natural gas.

Chinese, French, and U.S. seismic survey teams are searching for more oil reserves in Xinjiang and Qinghai's Qaidam Basin.

A new railway line is being built and existing ones are being electrified or double-tracked to ship out more coal and crude oil.

CSO: 4010/137

NATIONAL POLICY

PROSPECTS SAID BRIGHT FOR GUIZHOU ENERGY DEVELOPMENT

Beijing LIAOWANG [OUTLOOK] in Chinese No 34, 20 Aug 84 p 22

[Text] Not long ago the Communist Party Committee for Guizhou Province proposed that in the next 15 to 20 years Guizhou province, following the same route as Sichuan and Yunnan provinces, transform the construction of the Southwest into a self-sustaining base of energy, heavy and light industry, as well as large scale agriculture, able to support the modernization of the entire nation.

Energy is a key point in constructing this base. Guizhou province's vice-governor, Zhou Yansong [0719 5888 2646], a specialist in electric power, meeting recently with reporters, described the strong points and reserve strengths of the energy picture in Guizhou. He said: "Guizhou has rich reserves of water power and coal. Hydroelectricity and thermally generated electricity taken together are the strong point of Guizhou's energy picture. There is enough energy in Guizhou to satisfy the needs of the province and to support other provinces as well. In 1982 and 1983 alone Guizhou sent 1 billion kilowatt-hours of power to Sichuan and Yunnan. Guizhou's coal has been supporting Sichuan, Yunnan, Guangdong, Guangxi, Hubei, Hunan, Jiangsu, and Zhejiang. It has been shipped to Southeast Asia and Europe. In recent years traders from Japan, Italy, Federal Republic of Germany, England, France and other nations have come to Guizhou to discuss the development and export of Guizhou coal."

"Guizhou has much reserve energy. The exploitable potential for hydroelectric power is 13 million kilowatts, number 6 in the nation. However, only 7 percent of the total capacity is currently being utilized. Guizhou has coal reserves totaling 49.2 billion tons, in a complete variety of grades, in concentrated occurrences and easy to mine. But little is being mined today." Zhou Yansong majored in electromechanics at Hunan University and graduated before 1949. He went to work in Guizhou in 1965, serving as supervising engineer of the provincial electric bureau. In 1983 he was picked to serve as vice-premier, in charge of economic work. He said: "The various forms of energy are the 'rations' for the four modernizations. The more that is done with mechanization, automation, electrification, the more demand there is on energy. From 1950 to 1975, Japan had the highest rate of increase of energy consumption among the capitalist nations, 8.8 percent average per year. China in the first five-year plan period had the fastest rise in electrical consumption, 15 percent average per year. China's gross national product also showed the greatest advance, 10.9 percent average per year. If you understand this you will better understand the significance of the development and utilization of energy.

Guizhou is exceptionally well blessed with resources, for in addition to water power and coal, there is manganese, aluminum, antimony, mercury and limestone. These are of first rank nationally. The development and utilization of these resources cannot be separated from energy."

When speaking on how to give full play to Guizhou's energy strong points, Zhou Yansong said that it is a matter of transforming the now latent strong points in energy into actual economic strong points. This requires a series of difficult tasks. First, there is the development of the Wu Jiang. The Wu Jiang is one of the eight great tributaries of the Chang Jiang. It flows through the center of electrical demand for Guizhou, and it has been earmarked as the number one key construction base for hydroelectricity in China. The Wu Jiang runs 802 kilometers within the boundaries of Guizhou, with a great drop. Presently 933,000 kilowatts are being exploited, or only 12 percent of the total potential for hydro power. The main stations are the Wujiang Boshui station and the six stations on Zhiliu-Maotao locks. Plan to develop the entire Wu Jiang drainage is just being effected. With the coming of the development of the hydroelectric resource and the construction of power stations and locks, the water level will rise. This will change the narrow, sandbar- and rapids-ridden Wu Jiang into a river that is navigable in all four seasons. The opening of the Wu Jiang would amount to the addition of a new railroad through the heart of Guizhou, capable of linking up to the Chang Jiang.

Next comes the development of the coal resource in western Guizhou. The Liupanshui and Bijie areas in western Guizhou hold more than 80 percent of the coal resources of the entire province. The present capacity of Guizhou's coal pits is 13,090,000 tons; Liupanshui accounts for 10 million tons of that total. The five coal washing plants that have been built in the province are all in that area.

Third comes the rational utilization of resources, supporting the modernization of the Southwest and of all of China. With economic growth the power grids of the whole nation will be linked into one. Guizhou has a very strong asset in this respect, for in addition to exporting coal, Guizhou is also striving to be a base for thermal electric generation. Turning coal into electricity for export is one way of increasing social economic efficiency. Zhou Yansong concluded by saying: "Guizhou is rich in resources but lacking in technical ability. We welcome China's experts, scholars, and young technicians to come to put their abilities to work, to make a contribution toward the development of the Southwest!"

12663
CSO: 4013/231

NATIONAL POLICY

MINISTRIES STEP UP PLAN TO PROVIDE MORE ELECTRICITY

OW150949 Beijing XINHUA in English 0846 GMT 15 May 85

[Text] Beijing, 15 May (XINHUA)--Chinese ministries have combined to manufacture and install this year generators with a record capacity of 5 million kW, ECONOMIC DAILY reports today.

This will complete the 15 million-kW quota set by the Sixth Five-Year Plan (1981-1985).

Monthly meetings begun in March will continue to coordinate the efforts of the State Planning Commission and the State Economic Commissions, the Ministry of Water Resources and Electric Power, the Ministry of Railways and the Ministry of Machine Building Industry, the State Bureau of Materials and Equipment and the People's Construction Bank.

The generators, including three hydropower units, will be installed in 28 facilities throughout the country, particularly in the power-short northeast, north, and east.

ECONOMIC DAILY comments that electricity shortage is seriously restricting industrial and agricultural development.

CSO: 4010/145

POWER NETWORK

PROSPECTS FOR MODERNIZING POWER SYSTEM CONTROL CENTERS DISCUSSED

Nanjing DIANLI XITONG ZIDONGHUA [AUTOMATION OF ELECTRIC POWER SYSTEMS] in Chinese Vol 8, No 5, Sep 84 pp 3-10

[Article by Wang Pingyang [3769 1627 3152]: "Prospects for Developing Modern Control Centers in Power Systems"]

[Editor's Note] This article is part of the seventh chapter entitled "Prospects for the Development of Modern Control Centers" in the forthcoming book "Modern Electric Power Systems: Computer Application and Its Prospects," which is the first volume of the "Automation of Modern Electric Power Systems" series planned to be published by the Water Resources and Electric Power Publishing House. This article looks forward to the application of computer techniques to power systems and its trends in the 1980's and 1990's. The author and the publishing house consented in advance to our request for carrying the article in this journal for the benefit of the readers.

[Text] I. Trend of Miniaturization and the Structure of Computer Systems[1]

The development trend of the structure of computer systems from the 1970's to the 1980's is the use of single-host or duplex computers to take charge of the complete task of monitored control such as data collection, high volume repeated routine data processing and even communications control and high volume analytical computation. Later the prefixer was used to share much of the routine data collection, communications and data processing work. The current trend is to perform these tasks with multi-microprocessors, which demonstrate unprecedented flexibility and suitability. That is, development from Figure 7-1 to Figure 7-2. The first feature is the replacement of single-outlet mainframe by double-outlet super-minicomputers (that is, 32-bit minicomputers; the current general trend is toward multi-microprocessor structure using flow-line or vector computation). So-called single-outlet means each mainframe is equipped with only one set of prefixer with a different function; double-outlet means each mainframe cross links with two sets of prefixers, forming an arrangement called gradual degradation or fail soft. If an error occurs in one set of prefixer the second set will immediately take its place with no damage to operation except reduction in standby reliability. It is even equipped with three sets of display generators which enable CRT's on all control consoles to be always assured of normal information supply.

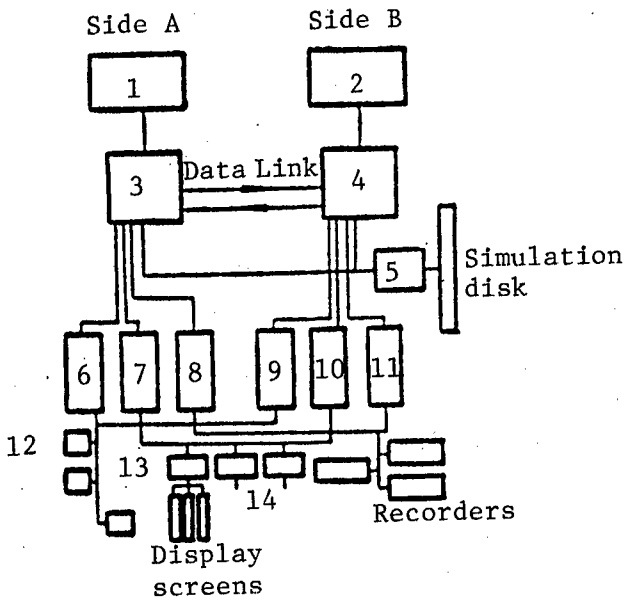


Figure 7-1. Single-Outlet Layout of Mainframe

Key:

1. Main storage
2. Main storage
3. Mainframe
4. Mainframe
5. Prefixer
6. Data collection
7. Display
8. Recording
9. Data collection
10. Display
11. Recording
12. Remote terminals
13. Data collection circuits
14. Display generators

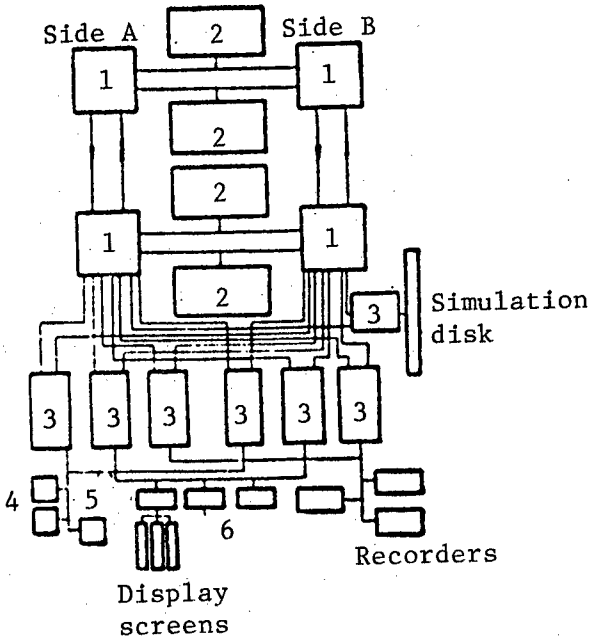


Figure 7-2. Double-Outlet Layout of Mainframe

Key:

1. Super mainframe
2. Large storage
3. Prefixer
4. Remote terminals
5. Data collection circuits
6. Display generators

The impact of microcomputers on the equipment technology of remote terminal units (RTU) is also considerable. The most significant development in remote terminal technology in recent years is the miniaturization of computers. After the miniaturization of computers, regardless of the speed of sampling equipment, microcomputers have buffer storage devices which invariably coordinate properly with information systems. The remote terminal is an equipment extensively used in large numbers. It is the biggest investment in an automated power system besides channels and is often bigger than that on a mainframe and is an indispensable part of the computer system. Therefore, when purchasing a computer system we should consider it with mainframes as an integral whole. But suppliers of remote terminal units are highly competitive since they frequently have their strong points in remote terminal technology because of their profession. At present, it appears that there can be relatively good coordination in giving the overall contract to mainframe suppliers and contract for RTU's to remote terminal specialists.

II. Trend in Range and Depth of Automation of Hydropower Plants, Transformer Stations and Power Systems

The development of microprocessors not only drastically increases the capability of control of central control centers, it also develops the intelligence of transformer stations and power plants in their functions of receiving and executing commands besides sending operation information, making it unnecessary for central control centers to seek large amounts or complete and detailed data and information from transformer stations, power plants and other terminals and unnecessary to give piecemeal instructions for the commands to be executed. This can greatly simplify the transmission of information between higher and lower levels and form a new state of control by levels.

"Non-attendance" of hydropower plants and transformer stations, that is, not putting regular personnel on duty, has already become a trend of the times. According to a survey by Japan at the end of 1980, the extent of non-attendance in several power systems in Europe and the United States is indicated in Table 1.[2]

Since the end of the 1970's, nine electric companies in Japan have formulated plans toward "fewer attendants," "single attendant" and eventually "non-attendance." As a typical example, the expected rate of non-attendance of the Kansai Electric Company from 1970 to 1980 will increase from 44.8 to 95.6 percent.

The main substance of the task of automatic control is remote control of attended hydropower plants and transformer stations. The function of their automatic processing generally includes (1) automation in monitoring the state of operation and display of the power system including over-limit alarm; (2) automation of records which keeps logs including those of operations and accidents; (3) automation in information transfer including automatic reports and dispatch of information to the control center at the higher level as well as information exchange between upstream and downstream during sluicegate operation. Take for example the control stations of the

Table 1. Non-Attendance Rates of Several Generating and Transformer Stations in Europe and the U.S.

Electric Company		Commonwealth Edison, Chicago, U.S.	National Electric Company of Italy	Central Electricity Generating Board, U.K.	Hamberg Electric Company, West Germany	French Electric Company
Hydropower Plants	Attended		156			47
	Unattended		408			403
	Non-attendance rate (%)		72			90
Transformer Stations	Voltage (KV)	765~139	380-130	400-275	380-110	400-63
	Attended	765~139	11	161	0	125
	Unattended	282	110	41	63	1,385
	Non-attendance rate (%)	100	91	20	100	92

Kansai Electric Company which have already used large numbers of 1:N type of telemechanical devices with functions of automatic data processing and executing commands.

III. Questions of Automation of Hydropower Plants and Non-Attendance

In the early 1970's opinions differed on the questions of automation of hydropower plants and non-attendance. Typical examples of differing opinions include the reports of some views in France which maintained that we should carefully consider abolishing the last person on duty.[3] For example, on the question of cooling water cut-off alarm for water turbine bearing lubricant oil, if guarded by someone on duty, generally only an alarm would be issued and it would not be necessary to stop the equipment. This is because it only requires the attendant to check the cause of water cut-off and once it is dealt with the trouble will be removed. If there is no attendant the machinery will have to be stopped in case it is not dealt with in time and the bearing burns out, otherwise the matter will become serious. Because of today's development in microelectronic technology, automation of hydropower plants has undergone a major change. The figures and estimates on non-attendance rate given in the previous section have already demonstrated this change.

Computers and the reliability of signal channels are obviously very important. Here, the structure of cooperation and division of work among multi-microprocessors is adopted (Figure 7-3), and it is believed that this is even more suitable to the above-mentioned goal than duplex computers. Two principal microprocessors are the PC and SMC. The PC is the mainframe which is equivalent to the regular monitor and control computer for the entire plant and which undertakes seven monitor and control tasks including six control operations. But because of the intelligent function of SMC it also reduces data D_3 sent to central dispatching and information D_1 collected from hydropower stations. Moreover, with the installation of a special event sequence recorder, routine work of the PC is drastically reduced. Consequently the scale of the PC does not exceed the level of a microcomputer which greatly improves reliability, respond speed and construction cost. In actuality the PC is formed by two microprocessors which divide the work; one microprocessor undertakes seven monitor and control tasks and the other is merely a programmable controller which is both simple and reliable. The most important measure in implementing six control operations is the SMC microprocessors. It monitors the mainframe PC's input and output of the information mainly for the KSR printer. If certain conditions are found in certain characters or data specifications, it will check, inquire or call the attendant according to the preprogrammed sequence. The SMC has telephone lines directly connected to the outside and can send clear and preprogrammed statements to dispatching stations. The SMC can accept the instructions sent and will implement them after analysis.

When attendants receive SMC calls, they can first use dialogs to gain an initial idea of the circumstances and then get a thorough understanding on the spot and deal with it. As a result it is not necessary to transfer large

amounts of data to central dispatching thereby reducing the demand on signal channels. Moreover, the SMC makes inquiries on the PC every 5 seconds and if anything extraordinary is found it will attempt to process according to preprogrammed sequence. If ineffective, it will call the central dispatcher. If there is no response to the first number called it will dial a second number.

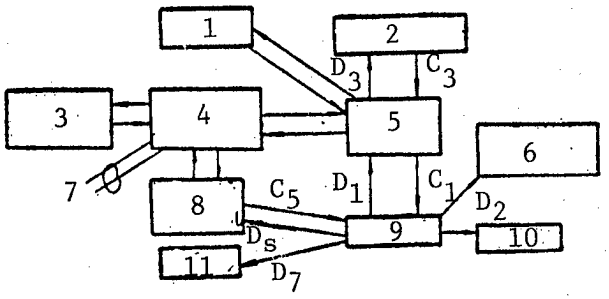


Figure 7-3. Layout of Multi-Processors

Key:

1. Black-and-white CRT
2. Central dispatching or dispatching station
3. KSR printer terminal
4. SMC monitor communication unit
5. Mainframe PC of hydropower plant
6. SER event sequence recorder
7. Telephone lines
8. BRTU backup terminal
9. Hydropower plant
10. Recorder
11. Alertor

In the figure, BRTU is the backup of several major key functions for the mainframe. In case of breakdown of the PC mainframe these principal functions can still be carried out by BRTU. Because no one is on duty at ordinary times it is still necessary for attendants at home to deal with accidents so that it is not necessary to be particular about the type of CRT used. All it takes is a small black-and-white CRT for dialog and for linkup between man and computer.

IV. Automation of Thermal Power Plants

Somewhat like Japan, experimentation in automation of thermal power plants in China did not have a late start and is only 1 or 2 to 2 or 3 years behind the United States. In the course of the unsuccessful Little Gypsy experiment in the United States, we have already conducted experiments in Gaojing and Shanghai Nanshi. Japan has basically caught up with the advanced international level in its automation of thermal power plants. We will first briefly describe the following: (1) course of development in Japan prior to the 1980's; (2) prospects of development from 1985 to 1990; and (3) possible realization of automated systems in the 1990's.

1. Course of Development in Japan Prior to the 1980's

Automation of thermal power plants in Japan began with through-flow boilers. After the use of computers, the rate of load increase grew from the original 3 percent per minute to 5 percent per minute. This was followed by the realization of automatic mainframe start-stop and then computer control of entire plants. So-called super automatic control which is currently being popularized refers to developing the intelligence of distributed (or dispersed) control. A key S&T project in realizing automation of entire plants is what is known as the FCB (fast cut back) machine which is also capable of dealing with accidents such as giving speedy supply of power. The successful research on this project is a major achievement. The specific substance of FCB is: when trouble occurs near the generators which loses their load, combustion in boilers must be correspondingly reduced at the same time. In order that power supply returns promptly after the trouble is removed, continued operation of the steam turbo-generators with the station's load must be maintained so that a minimum operation of burners must be maintained. But since the flow volume of steam has been drastically reduced we must prevent blow-out of the reheater. This is therefore a set of rather complicated controls which was completely worked out at the end of the 1970's.

2. Prospects of Development From 1985 to 1990

From the 1970's to the 1980's, generating units in the automation of thermal power plants have been able to start or stop under computer commanders, known as automatic start-stop, which is a great achievement. Whether it is a hot start-up or cold start-up it is carried out under computer monitoring and control (not necessarily direct control by computer; direct control by computer is abbreviated as DDC). That is to say, this is carried out according to the start curve, with each action carried out by traditional automatic installation (which are now composed of large-scale integrated circuit components or microcomputers). The result of implementation is checked by computer to determine whether the next operation is possible. In this way, each step is monitored and decided by the computer which also issues the instructions for the next action. Such monitor and control has been worked out.

Looking ahead beyond 1990, the most notable change will be similar to power system automation in that microprocessors will enter every traditional executive control component, realizing development toward intelligence until forming dispersed control systems of entire plants. General command of entire plants and concentration of information as well as linkup with dispatching centers of power systems will be undertaken by multi-microprocessors. Not only is the function of the multi-microprocessor strong, its internal storage is as much as 8 megabyte. The linkup between the switchboard and various terminals and various workshops will develop from the fast channels of coaxial cable to anti-interference channel of optical fiber cable. In this way, we may consider centralizing the recording instruments, display instruments and operation signals of entire plants. Multiplex technique of channel may be utilized so that cable-laying technique of entire plants will undergo a fundamental revolution. Supply firms which attended seminars in China in

the early 1980's proposed this kind of programs on more than one occasion. Microprocessors and programmable controller have been adopted in the HIT ASS for steam turbo-generator control and HISEC for boiler control used by Hitachi Corporation in Japan. It appears that the time for the realization of dispersed microprocessor control of entire plants may not be far from now.

3. Possible Realization of Automated Systems in the 1990's

The application of an automated system of multi-microprocessor controlled at different levels and in a dispersed way is a new technology that may be realized in the 1990's. The construction of this system uses several groups of microcomputers which take care of the task of automatic control on the spot and undertake the task of mutual communication (exchanging information) thereby saving and simplifying complicated and numerous control cables and improving reliability. Its principles are briefly shown in Figure 7-5.

The small circles in the figure are parts of the networks of various workshops such as automobile, boiler, electric, coal transportation and recycled water workshops. Various workshops have different types of microcomputers to carry out different functions. For example, the boiler workshop has spraying burner first blast, second blast, water supply, temperature control, combustion control, dust-blowing, slag removal and so forth. Some interactive workshops exchange information in their own workshops while some need to transmit to other workshops. The exchange within a workshop is sent through communication controller R while delivery to other workshops is through communication controller M including exchange of information between electric workshop or the main control room with central dispatch. These communication links and networks are based on the bidirectional bus so that the transformation of information can select the shortest route or one with the least traffic and waiting. This arrangement is also more convenient for expansion and suits the expansion of power plant arrangement in new buildings. A multi-loop system with different levels permits the application of different communication transmission devices such as strands, coaxial cables and optical fiber cables within different links. In this way, partial control is dispersed but dialog information with the main control room is centralized.

Distributed multi-level control systems using microcomputers have the following advantages:

(1) Long-distance microcomputer terminals have better intelligence and capacity; monitored by operators they process a power plant's on-the-spot control of all the information needed.

(2) Intelligent terminal microcomputers for on-the-spot control are installed next to the equipment to be controlled so that they have the greatest economization of control cable, and this gives play to their independent intelligence and realizes more prompt and careful control.

(3) Microcomputers are relatively flexible and can link up with various surveying instruments, sensors, converters, actuators and other large, mini and microcomputers.

(4) Various microcomputer terminals are linked to communication networks and the communication controller selects the shortest and the least trafficked route to exchange information.

(5) Theyuse on-the-spot computation and partial data and other software methods so that the traffic volume of communication network terminals are maintained at a minimal which saves the capacity of signal channels and keeps these channels open and unhindered.

(6) They yield enormous results in economizing the construction space of thermal power plants. They can economize on cable huts, reduce cable channels and braces which are also shortened. The entire main control room and control building can be designed to be even more compact at an even lower construction cost.

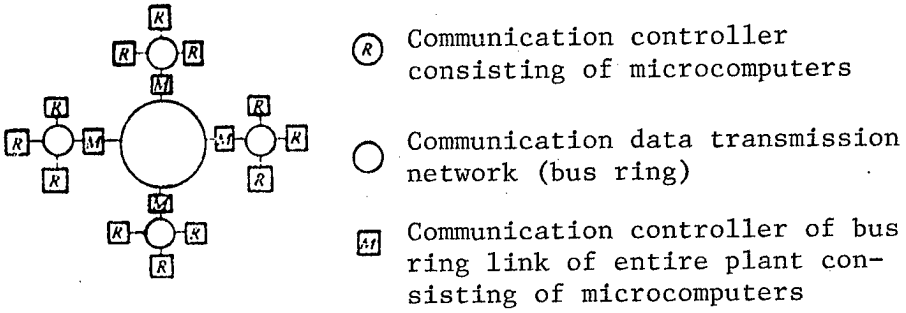


Figure 7-5. Schematic Diagram of Stratified Information Network of Entire Plant

V. Automated Power Supply and Consumption and Enterprise Management

In the course of rapid modernization of power production, past "emphasis on production, neglect of supply and not caring for application" which put the emphasis on generation of electricity had caused city power systems and trans-provincial power systems to become increasingly backward and turn into weak links. Today, as we stress power generation we also gradually stress power systems, and we also pay certain attention to the automation of power systems. However, automation of power supply and power consumption management has not kept up in pace. The tide of the information society has already swept across Europe, the United States, Japan and into China. Information in power supply and consumption is the information source of automated power systems. Therefore, it can be regarded as the most basic foundation of automation. Foreign countries have already elevated automation technology of power supply and consumption to one of the basic techniques in an information society. China has done some work in the transformation of power systems in large cities, power frequency and audio frequency load control as well as distributed control but the gaps are considerable compared to the demands of an information society.

The specific substance of automation of power supply and consumption has load control and handling accidents which are discussed as follows:

Load control functions which will soon be realized include: improving load curves, increasing the utilization rate of transformers and feeders, improving the maximum amount of time close to load and strict monitoring of load changes. If the limit is exceeded it will automatically switch over to the feeder to shift the load. Moreover, we can even utilize the short-term overload capacity and improve the level of load forecast, and the agility and quickness in monitoring and shifting load can further increase the utilization rate of existing equipment and guarantee safe consumption of electricity and equipment life. Accurate recording and computation of data on load control logged daily can provide an accurate basis for the development program of power distribution systems.

In the handling of accidents, emergency load shedding maintains safety and stability of the power supply system up to the major system of linked network. At the same time, power cut of domestic consumption can be selectively reduced, which will better safeguard consumers whose power should not be cut off. Such careful and differentiated treatment can only be achieved in power systems at the first distributed level. Besides, using automated power supply and consumption to improve the method of locating trouble spots and coordinate with distant isolation of breakdowns can even speed up the resumption of power supply.

VI. Data Link and Data Network

Many years ago each power system operated on its own and though they were linked to neighboring networks the volume of data they exchanged was small and there was no necessity to understand the conditions of neighboring networks as they conducted their work according to contracts. Since wide areas of power stoppage occurred in the major linked network (up to the 1980's; and there has always been more than 10 occasions of power stoppages over large areas in each of these past few years) so that more and more attention has been given to the issue of safety control. The issue of safety of linked networks must consider the mutual effect among neighboring networks. Therefore the volume of information among them is increasing day by day. For example, the real-time data of arrangement and planning of power generation, bus voltage, circuit trends and network structure have become information that must be mutually understood. The necessity of public data network has been gradually placed on the daily agenda. The current trend of data network used internationally is packet switching and the X.25 Network Provisions of the CCITT. It appears that the method to be adopted will be setting up a special group of prefixers to exercise particular control over the decoding and management of formats of the provisions. The trend is clearly the general adoption of the X.25 information links among major networks. There is also a trend to develop X.25 provisions for links among computers within the network in the future.

The first to apply the X.25 provisions in modern power systems was the French main state network Rationa transmission provisions but it is only applied at the fourth level, that is, the transmission level (see description below).[6] The first to apply the X.25 provisions at the first, second and third levels,

that is, application, representation and (see description below) was the West European High-Voltage Grid of the Union for Coordinating Production and Distribution of Electricity (UCPTE) which has adopted the agreement structure set up by the International Standardization Organization (ISO).[7] The French Ratina transmission provisions has not yet been adopted as international standards but future international standards may be close to resembling the Rationa provisions.

The West European High Voltage Grid of UCPTE composes of eight countries including West Germany, France, Italy and Switzerland. Each has a different history of power system development, each uses a different computer and each has its own provisions for information exchange within its system. After the formation of the West European power grid, centralized data transmission provisions were urgently needed, but due to different circumstances in each country, strong independent national character as well as conservative thinking, the proposal to adopt centralized provisions has not been accepted by all the countries. This problem must be solved as the international volume of information exchanged increases.

Figure 7-6 shows the arrangement of the seven independent levels in the open system structure set up by the ISO. Each level can be regarded as a distribution subsystem and the next level provides the service. This makes the function of transmission even more transparent (transparent means that the contents transmitted will not change regardless of the transmission process, just as the image obtained by looking through a transparent glass is entirely the same as the original), and at the same time the functions of data processing and transmission are respectively even more accurate.

The UCPTE has adopted this basic structure, but gradual realization of this structure requires a relatively long period of transitional process, with a large number of processes to formulate standardizations, software development by manufacturers and tests and trial use. An outstanding advantage of this system is that application of the original system can still be maintained during the period of transition.

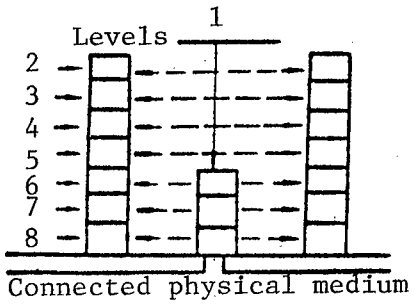


Figure 7-6. Structural Model of ISO Open System

Key:

1. Central Dispatching Points
2. Application
3. Representation
4. Conferences
5. Transmission
6. Networks
7. Links
8. Physics

VII. The Question of Man-Computer Interaction and Data Base

Looking ahead to the next decade or so, great changes may occur in man-computer interaction.[1] The color CRT is a method of display almost in general use. But the meanings represented by colors are very inconsistent particularly in safety monitor and control. It appears that centralized standards are needed to distinguish parts that are charged and not charged, and how to display states of accidents or emergencies. What is entirely consistent is merely the use of "flashing" as an alarm signal to indicate that it has not been determined by the dispatcher. Current color display technology can already use three background colors and seven patterned colors to represent different circumstances. Unified stipulations on colors are needed which will benefit operations as well as manufacturing and supply.

Due to the increasing amount of information that needs to be displayed, semi-graphic CRT's can no longer satisfy the demand while orders for full-graphic display units have already been placed in Europe and the United States. The pixel resolution has reached a lattice of 512 x 512 and soon there will be commodities that are 1024 x 1024 (a level reached by the full-graphic display units in the price quotations from AYDIN of the United States in this import of automated power system by China).

The method of representative data will also undergo considerable change. Direct visual comprehension more convenient to the dispatcher will be used to replace the currently used determinantal data charts such as bar charts and curve tendency charts (at present the pen-drawn recording instrument is still the instrument most emphasized by dispatchers in BPA, TVA and other dispatching centers, wall display devices seen by front dispatchers are several tens of pen-drawn tendency recorders). Some reform will be carried out in display methods that suits increased efficiency of man-computer interaction.[8] At the symposium of the 35th professional committee of the International Large Power Networks in the Bergen area in Norway, someone raised the issue of wall simulation disks and believed that they will continue to be used in main central dispatching centers but that there is a trend to discontinue its use in regional dispatching centers for the control of distribution circuits. It was also mentioned that the assembly drawing to be used in the future may be 5 x 2 meters multi-color laser pictures.

Considerable progress has been made in the issue of data base.[10] In the 1970's the method of input of document programs into computers required translation into machine language, determination of the real physical addresses in computers and proper linking before they were input into the resident areas of internal storage or disks for use at any time. When there was a need to expand or revise files and data it was necessary to relink, move or revise addresses and the amount of work was considerable. Later, although the use of pointers facilitated revision time and linking, the time spent on tracing and searching for addresses back and forth between former and latter areas according to pointers was too long and increased "overhead" (overhead generally refers to expenses of non-direct profits in business stores such as housing, facilities and non-productive employees; programs which serve and support

computations in computer programs, which do not directly produce computation results and which are indispensable are also known as overhead). The biggest work volume in data processing is the search for needed data, which is then re-stored in their proper addresses after computation processing. Therefore, with the sharp and "explosive" increase in information data, data storage techniques have become highly important. As a result, the special technique of what is known as data base management system (DBMS) has been developed so that the storage, expansion, protection, revision, search and application of data can provide convenience and satisfaction for everyone even though there may be competition for using the same database by multiple quarters at the same time. This technique is simply called database technique. The first database technique that came out is used by data centers for off-line computation which are enormous in scale and thorough and are not entirely suitable for on-line application. Excessive overhead in on-line use will prolong on-line response time to 10 to 30 seconds, which is hard to be accepted by dispatching personnel. Currently the respond time demanded by dispatchers in general does not exceed 2 seconds. The direction of solving this problem is first improving on-line database while expanding internal capacity as much as possible, from 2, 4 and 8 megabytes or even greater capacity. The prospects are very good.

REFERENCES

1. H. Amelink and A. G. Hoffmann, "Current Trends in Control Center Design," ELECTRICAL POWER AND ENERGY SYSTEMS, October 1983, pp 205-211.
2. "An Outline of Control Stations in Japan and Overseas", ELECTRIFICATION REVIEW, June 83, p 9.
3. "Automation of Hydropower Plants in France," FRENCH REVIEW OF ELECTRIFICATION PGE, 1973 No 2.
4. "History of the Development of Control Technology of Thermal Power Plants," THERMAL-AUTOMATIC POWER GENERATION, April 1982, p 91.
5. Edward H. P. Chen et al., "A Coordinated Statewise Load Management and SCADA System," PICA 83, pp 167-172.
6. H. P. Asal, "Information Exchange Between Control Centers in the West European High-Voltage Grid," October 1983, pp 236-240.
7. T. E. Dy Liacco, "Editorial for Power System Control Centers," ELECTRICAL POWER AND ENERGY SYSTEMS, October 1983, p 203.
8. Human Factors: Review of Dispatch Control Centers; IEEE Committee Report, October 1981.
9. "The Second Generation of Computerized Control Systems," ELECTRA, No 83, pp 6-38.
10. R. Lehman and J. Mattioni, "Data Base Methods in Power System Control Centers" ELECTRICAL POWER AND ENERGY SYSTEMS, October 1983.

9586
CSO: 4013/44

POWER NETWORK

CONFERENCE ON 500 KV TRANSMISSION ENGINEERING HELD

Beijing DIANLI JISHU [ELECTRIC POWER] in Chinese No 3, 5 Mar 85 p 9

[Text] The Conference on 500 KV Transmission Engineering sponsored by the Electric Transmission and Conversion Committee of the China Electrical Engineering Society was held in Jiujiang City. Attending the Conference were 82 representatives from 43 different organizations which included design, processing and manufacturing facilities as well as universitites, colleges and research institutions. A total of 36 papers were received: 20 were on electrical topics and 16 were on topics of line structures.

At the recommendation of the Transmission and Conversion Committee, the Conference announced the establishment of a structural subcommittee and an electrical subcommittee. The Huadong Electric Power Design Institute is responsible for organizing the electrical subcommittee and will serve as its sponsoring unit. The Dongbei Electric Power Design Institute is responsible for organizing the structural subcommittee and will serve as its sponsoring unit. The units are responsible for organizing and promoting technical activities in each field of specialization.

During the main conference, six delegates presented papers which discussed such issues as the electrical parameters of the second batch of the 500 KV transmission lines, the tower design, and measures to reduce the construction costs of transmission lines. During the special sessions on electrical and structural issues, 24 papers were presented: 13 on electrical topics and 11 on structural topics.

The representatives conducted discussions and critiques of the papers presented, and also participated in extensive dicussions of ideas of future activities and plans for the Society. It was generally agreed that most of the papers were of sufficiently high standard to be valuable references for future engineering design of transmission lines. For example, at the electrical subcommittee session, the paper given by the Xinan Electric Power Design Institute, "New Method of Calculating Insulated Overhead Ground Wire--The Application of EMTP and Analysis of Results", proposed a new method of calculating gaps based on transient state considerations; the papers presented by the Electric Power Research Institute, "Study of the Electric Field Distribution of the Haicheng--Dalian 500 KV Transmission Line to Determine the Ground Separation Distance" and

"Opinions on the Range of Relocation of Residences and Crossing of 500 KV Transmission Lines" were examples of close coordination between scientific research and production activities. In particular, the proposed "triangular array" Haicheng-Dalian line which uses 10.5 m ground separation distance over open fields has practical design implications. At the structural subcommittee session, the papers given by the Power Construction Research Institute, "Stability of Heavy Trust Members Under Load--Theoretical Analysis of the K-shaped Base Bars of Steel Towers" and "Several Problems of the K-X Type Steel Tower Structures" proposed an accurate and convenient method of computation which has been used in the design of the 500 KV towers; the paper given by the Dongbei Electric Power Design Institute, "Normal Cross-section Strength Calculation of a Circular Steel Reinforced Concrete Structure Under Offset Tension Load" provided a simple, clear formula which has been accepted by the "Basic Technical Standards."

Comrades at the Conference also provided valuable suggestions concerning future activities of the subcommittees, and proposed research topics for the second generation tower design and the development of new technologies for the 500 KV transmission lines.

3012
CSO: 4013/122

POWER NETWORK

JILIN'S POWER SHORTAGE EXPECTED TO BE RESOLVED BY 1990

SK200519 Changchun JILIN RIBAO in Chinese 29 Apr 85 p 2

[Article by Li Wen, director of the Provincial Power Industrial Bureau: "Accelerate the Construction of the Provincial Power Industry"]

[Excerpts] Our province's power industry once was in a leading position in our country but now it is lagging behind. Before 1966, our province ranked 2d in the country in installed power capacity, but now ranks 14th. The slow increase of power supply and the substantial increase of power consumption in the people's livelihood and the industrial and agricultural production brought about an increasingly serious contradiction between the supply and demand of power, and a power shortage for several years continuously. In the past year, power supply in the province fell short of demand by 15 percent on the average; and in the first quarter of this year, the figure increased to 20 percent. The shortage of power forced us to frequently restrict the supply, thus directly affecting industrial and agricultural production and the people's livelihood across the province. It is estimated that the power shortage causes a reduction in the provincial output value of 5 billion yuan annually, about one-fourth of the total provincial industrial and agricultural output value. Even the power needed for grain threshing and milling and feed processing cannot be ensured. The power shortage has also seriously affected the development of town and township industry. Thus accelerating the construction of power industry to relieve the contradiction between power supply and demand and solve the power shortage is top priority.

The basic way to solve the power shortage is to broaden sources of power and reduce power consumption, focusing on developing power sources by building a large number of new power supply stations. Economizing on power consumption is also of great importance. Last year, the province saved 465 million kWh of electricity, about 3 percent of the total power supply in the province. This played an important role in relieving the contradiction between power supply and demand, and thus continued efforts should be made.

According to our tentative plan, in the future, we will utilize the water resources in the east part of the province to build a hydroelectric power base with an installed capacity of more than 3 million kW, and with Fengman, Baishan, Hongshi, Shuanggou, and Xiaoshan hydropower stations as the key link. We will also utilize the advantages of the western province, which is close to the

Huolinhe and Yimin coal mines, to build a thermal power base there with a total installed capacity of 5 to 6 million kW, which includes the Baicheng, Taonan, Qianguo, Daan, and Daanbei thermal power plants with the Baicheng and Taonan stations being the central stations. Meanwhile, we will build an integrated thermal power production center in the central part of the province, with Changchun and Jilin cities as the main body. In addition, the province will build a centralized heating network among large and medium-sized cities.

In line with this tentative plan, in addition to accelerating the construction of the second-stage project of the Baishan Power Station and the Hongshi Power Station, we will build a number of thermal power plants in the central and western parts of the province, including the sixth-stage expansion of the Jilin Thermal Power Plant, in which two 200,000-kW generating units will be installed; the building of the new Changchun Thermal Power Plant in which two 200,000-kW heating units will be installed; the expansion of the Changshan Thermal Power Plant, in which two 200,000-kW coal-consuming generating units will be installed; and the building of the Hunchun Power Plant, in which two 100,000-kW generating units will be installed. By 1990, a total of 2.58 million kW of hydroelectric and thermal power generating units will be put into production, and the total provincial installed capacity will reach 5.5 million kW, both doubling the present figures.

This year, the province will terminate its 20 years of stagnation in power industrial construction and will soar to great heights in this regard. This year, construction of two large power plants--the sixth-stage expansion of the Jilin Thermal Power Plant and the expansion of the Changshan Thermal Power Plant--will begin one after the other, and their first 200,000-kW generating units will be put into production in 1987. In addition, the province is accelerating preparations for the construction of the Changchun Thermal Power Plant and the Hunchun Power Plant, on which construction will begin next year. Such construction is so far the largest in the province's power industrial construction. In the course of building these four large and medium-sized power projects (the Jilin, Changshan, Baishan, and Hongshi Power Plants), we will build five high-tension power transmission lines and five primary transformer substations. This is an extremely arduous task. We must concentrate our human, material, and financial resources on winning the first battle for the vigorous development of the provinces's power industry.

CSO: 4013/140

POWER NETWORK

COMPUTERS COORDINATE GUANGXI'S HYDRO, THERMAL POWER OUTPUT

HK131526 Nanning Guangxi Regional Service in Mandarin 1130 GMT 11 May 85

[Text] The scientific research achievement of using microcomputers to decide in several minutes to an hour the best way of operating the eight hydropower plants and five thermal power plants in the four rivers in the region and in Nanning, Liuzhou, Guilin, (Heshan), and (Pingdong); scientifically predicting the economic burdens of all the power plants the next day; and readjusting on a timely basis the balance of hydropower-generated electricity and thermal power-generated electricity passed the scientific assessment conducted jointly by the Guangxi Science and Technology Commission, the Electrical Science Research Institute of the Ministry of Water Resources and Electric Power and the Guangxi Electric Power Bureau.

The specialists unanimously held that this new technology reaches international levels and deserves to be promoted and applied in the hydropower and thermal power combined electrical departments in the country.

The characteristic of Guangxi's electrical departments is that hydropower-generated electricity accounts for a large percentage and all hydropower-plants are riverbed-type low-water-level power stations with small capacity reservoirs and poor regulating ability. In order to generate more electricity in high water seasons, to reasonably distribute water in lower water seasons, to strictly control the changes of water level in reservoir areas, and to create conditions to generate more electricity, in February last year the control office of the Guangxi Electric Power Center, on the basis of summing up the experiences over the years, joined hands with the electric network automatic control office of the electric science office under the Ministry of Water Resources and Electric Power to conduct research on the above subject. Through their year-long efforts, they have worked out and debugged the hydropower-thermal power combination procedure and officially put it into operation in Guangxi's power network in early March this year.

CSO: 4013/140

POWER NETWORK

BRIEFS

TIANJIN 500KV SUBSTATION--On 1 April, Tianjin Municipality started building an extrahigh-voltage 500KV transformer substation at Xiaozhu village in Zhutang Township in the northern suburbs. The largest substation in the municipality, will transmit power generated by the Shentou power plant in Shanxi Province to the municipality. The building of the substation will provide the municipality with 300,000 kW of electricity, equal to the volume of a new large-sized power plant, relieving the strained power supply situation. [Text] [Tianjin TIANJIN RIBAO in Chinese 2 Apr 85 p 1 SK]

POWER OUTPUT--Beijing, 1 April (XINHUA)--China generated 95.7 billion kilowatt-hours of electricity between 1 January and 31 March, accounting for 24.2 percent of the annual plan. This was an increase of nine percent over the same period of last year, according to the Ministry of Water Resources and Electric Power today. The January-March crude oil output was 30,230,000 tons, 24.38 percent of the annual quota and up to 10.28 percent over the same period of 1984. [Text] [Beijing XINHUA in English 0631 GMT 1 Apr 85]

OUTPUT SETS RECORD--Shanghai, 10 Apr (XINHUA)--The [East China] Power Network generated more than 13.3 billion kilowatt-hours of electricity in the first quarter, topping all previous records for the same period, and is 10.9 percent more than the same period last year. Since the beginning of this year, the administrative bureau of the Huadong Power Network, which is responsible for the power supply for Jiangsu, Zhejiang, Anhui, and Shanghai, had adopted a responsibility system in power generation, and power and fuel consumption, which has aroused the enthusiasm of these localities in power generation. [Summary] [Beijing XINHUA Domestic Service in Chinese 1452 GMT 10 Apr 85 OW]

HUNAN 1ST QUARTER OUTPUT--In the first quarter of this year, the province's power industry departments generated 3.469 billion kilowatt-hours of electricity, an increase of 29.5 percent over the same period last year. [Summary] [Changsha Hunan Provincial Service in Mandarin 2300 GMT 30 Apr 85 HK]

CSO: 4013/140

HYDROPOWER

HYDROPOWER BASE ON UPPER CHANG JIANG DESCRIBED

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 12, 12 Dec 84 p 63

[Article by Ji Shi [4764 1395]: "The Hydropower Base on the Upper Course of the Chang Jiang"]

[Text] The section between Yibin and Yichang on the upper course of the Chang Jiang is usually called the Chuan Jiang. The total length is 1,030 km, the area of the basin above Yichang is 1 million square kilometers, the long-term average flow rate is 14,300 m^3/sec, the long-term average runoff is 451 billion m^3/sec and the total drop in this section is 220 m. Preliminary planning determined that 20 million kW of generators may be installed to produce 102.5 billion kWh per year. This section of the Chang Jiang is a huge energy reserve.

From Yibin to Fengjie, the main stream of the Chang Jiang goes through the Sichuan Basin and cuts through alternating hilly terrain and plains. Superior hydropower dam sites exist in the alternating narrow and open sections of the river. From Fengjie to Yichang is the famous Sanxia valley where the river is confined to mountains and a number of locations are good for tall dam construction. The development of this section of the river, combined with the construction of dikes in the middle and lower courses of the Chang Jiang and various flood control measures, may reduce the flood hazards in the lower course of the Chang Jiang, improve the water transportation in Chuan Jiang and in the lower and middle courses of the river, and provide the conditions necessary for directing the water in the south to the north.

Qing Jiang is an important tributary of the middle course of the Chang Jiang. It has a basin area of 16,700 km^2 and enters the Chang Jiang at 40 km below Yichang. The section from Enshi to Changtan is 250 km long and has a 355 m water head. Preliminary planning calls for 2 million kW of hydropower development which in the short term may solve the energy needs of the Jianghan plains, reduce the flood danger at Jin Jiang, and improve the river transportation of Qing Jiang.

The development and research of the upper main stream of the Chang Jiang began with the surveys and plannings made in the 1930's. The Guomindang government collaborated with the Bureau of Reclamation of the U.S. Department

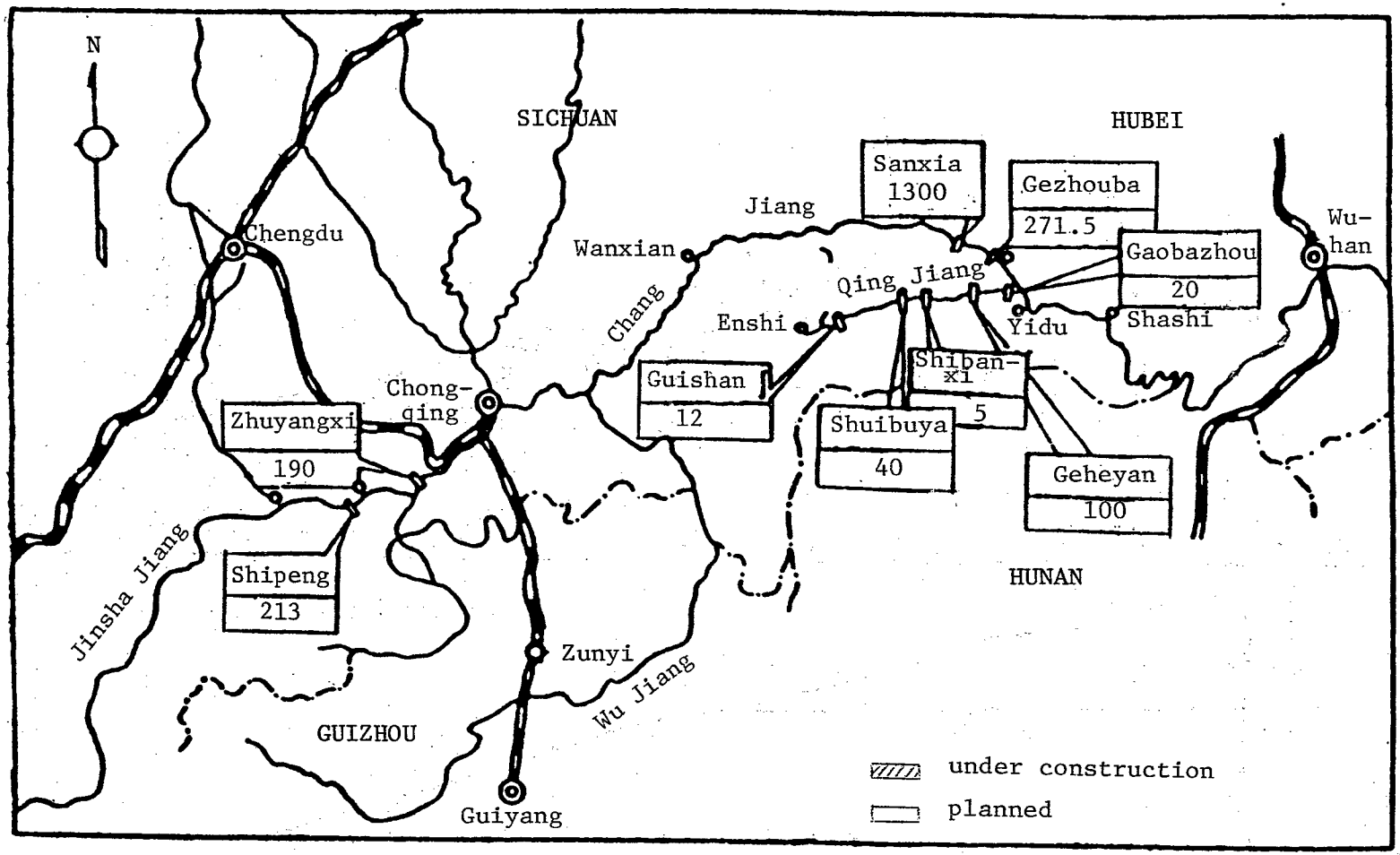


Fig. 1. Locations of hydropower stations on the upper course of the Chang Jiang and the Qing Jiang

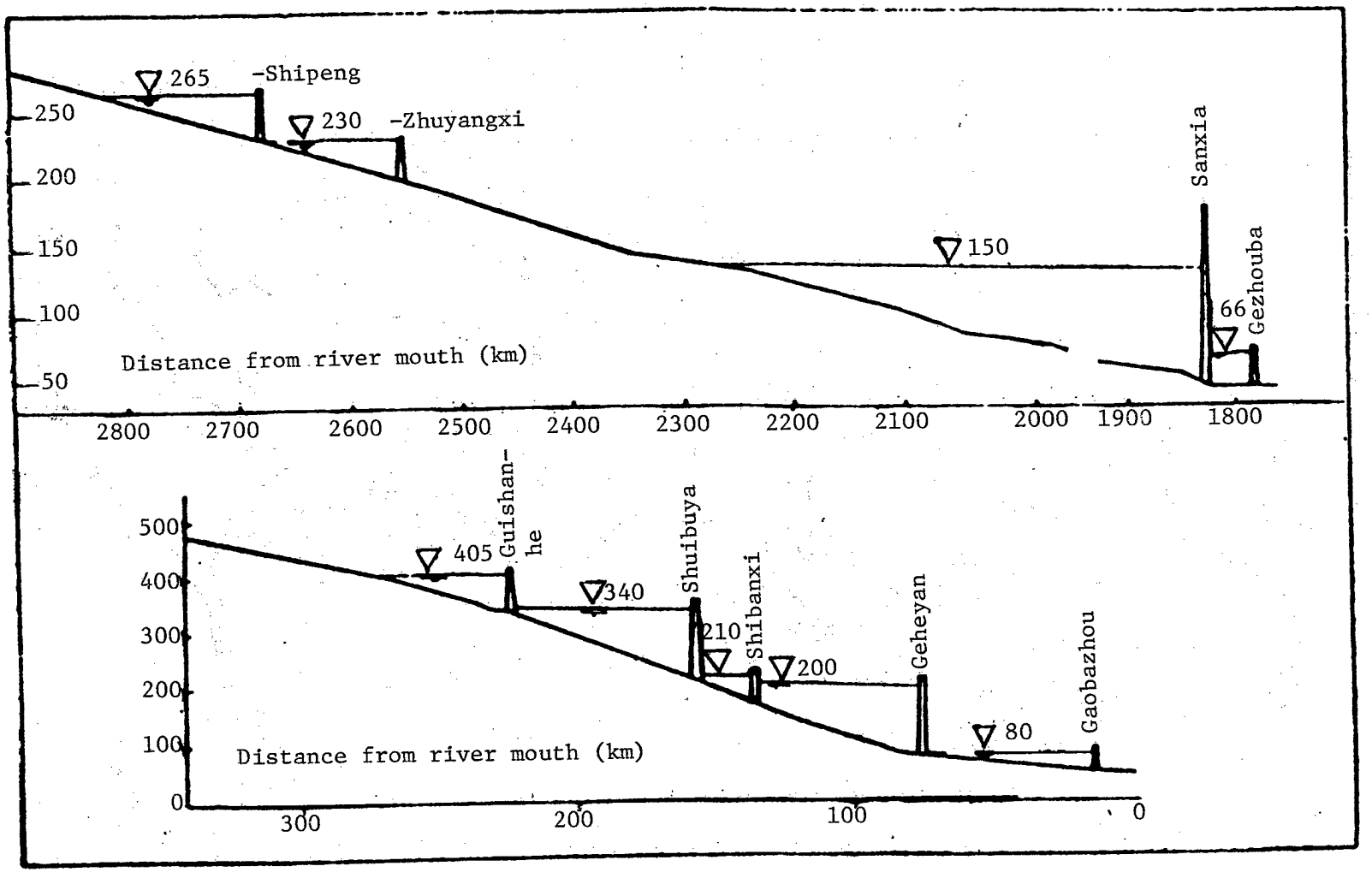


Fig. 2. Cross-sectional view of the cascade development of the upper course of the Chang Jiang and the Qing Jiang

of the Interior in the 1940's in conducting some of the preliminary work. After the Revolution, the Central Committee formally launched plans to develop the Chang Jiang basin after a hundred years of floods. As of now, the tentative plans call for a four phase development of the upper course, namely, Shipeng (2.13 million kW), Zhuyangxi (1.90 million kW), Sanxia (13 million kW), and Gezhouba (2.715 million kW). The Qing Jiang development has also been planned several times, the tentative plan calls for a five phase or four phase development of the main stream below Enshi. The five phase development plan will be Guishan He (120,000 kW), Shuibuya (400,000 kW), Shibanxi (50,000 kW), Geheyan (1.2 million kW), and Gaobazhou (200,000 kW), with a total capacity of 1.97 million kW. The four phase plan will combine the Guishan He and Shuibuya project and build a tall dam at Shuibuya with a capacity of 1 million kW and the total capacity will be 2.45 million kW. Figure 1 shows the locations of the hydropower stations on the upper course of the Chang Jiang and Qing Jiang, and Figure 2 shows the cross-sectional view of the staged development. In the development of the Qing Jiang main stream, the power stations at Geheyan and Shuibuya will be the pivotal projects. The Geheyan hydropower station will have a highly integrated utilization efficiency and good construction and transportation conditions. The beginning phase of the construction is very favorable and the technical economic indicator is superior. The preliminary design has been completed. The Geheyan project will be the first phase of the construction, followed by the Shuibuya project. The Gaobazhou reservoir will be a regulatory reservoir downstream from the Geheyan hydropower station and will also be one of the better hydropower stations in the area.

The first phase of the construction of the Gezhouba hydropower station began in 1981 and the second phase work is underway. The Gezhouba project is expected to be completed during the Seventh Five-Year Plan period.

The well-publicized Sanxia [Three Gorges] project is an important pivotal project of the Chang Jiang hydropower base. It has superior geological, geomorphic, and geographic conditions and will have enormous flood prevention, power generation, and river transportation benefits. However, the loss from the flooding operation will also be great. Chinese engineers surveyed the Sanxia area in 1933 and made preliminary plans. The U.S. Government subsequently sent people to help the Guomindang government, but only limited surveys were made up until the Revolution. After the Revolution the Chang Jiang Basin Planning Administration and the associated departments and local governments have done a lot of work and submitted several proposals. Recently, the normal water level of the Sanxia project was tentatively determined to be 150 m, the dam height will be 175 m, and the capacity will be 13 million kW. At the moment scientific research, preliminary design, and hydropower development preparation are being concentrated upon. After the completion of the Sanxia project, flood prevention on the middle course of the Chang Jiang will be improved. The Sanxia hydropower station is within the 1,000 km economic power transmission range of Shanghai, Guangzhou, and Beijing where most of the electrical loads are concentrated. It will be mainly supplying power to central and eastern China and eastern Sichuan. The reservoir zone will have 400-500 km of deep-water navigation routes, the dangerous rapids on Chuan Jiang between Changshou and Yichang will be flooded and the route below Gezhouba will be improved.

9698
CSO: 4013/119

HYDROPOWER

CONSTRUCTION OF HONGSHUI HE PROJECTS NOW IN 'FULL SWING'

OW151003 Beijing XINHUA in English 0746 GMT 15 May 85

[Text] Beijing, 15 May, (XINHUA)--Construction is now in full swing on a southwest China hydroelectric power network designed to produce 60 billion kilowatt-hours a year, PEOPLE'S DAILY reported today.

Of the 11 power stations planned along the Hongshui He, 2 are in operation and 3 are being built.

Preparation has begun to build more on 1,200 kilometers of the 1,500-kilometer Hongshui He in Guizhou, Yunnan, and Guangxi, covering its 1,100-meter drop from the Yunnan-Guizhou plateau.

Work to develop the hydropower resources of the river began officially in 1981 by State Council decision. The network will be completed by the year 2000, PEOPLE'S DAILY reported.

The Etan power station on the lower Hongshui He has produced 1.2 billion kilowatt-hours of electricity since going into operation in 1981.

The Dahua station has four generating units, three in operation.

The 11 stations will have a combined generating capacity of 11 million kilowatts, the paper said.

The cascade network is vital to the economic development of southwest China, inhabited by many minority ethnic groups.

It will alleviate the chronic shortages of energy in Guizhou, Yunnan, and Guangxi.

The paper does not specify the construction cost of network, but says that World Bank and Japanese loans will be used to build two stations.

CSO: 4010/141

HYDROPOWER

PLANS CALL FOR COMPLETION OF MANWAN BY MID-1990'S

HK230717 Beijing ZHONGGUO XINWEN SHE in Mandarin 1503 GMT 22 Apr 85

[Report: "Large Hydropower Station To Be Built on Middle Reaches of the Lancang Jiang"]

[Text] Kunming, 22 Apr (ZHONGGUO XINWEN SHE)--A large hydropower station with a capacity of 1.5 million kilowatts, the Manwan Hydropower Station, will be built on the middle reaches of the Lancang Jiang. The capacity of this hydropower station will be greater than the total capacity of all hydropower stations in Yunnan at present.

The Lancang Jiang is on the southwestern border of China. ABout 2,000 kilometers of this river are inside China and the remaining part outside China's territory is called the Mekong River. The Lancang Jiang is rich in water resources and is one of the 10 major hydropower bases to be developed in China. In building hydropower stations here, the amount of land to be submerged is small and the number of people to be evacuated is small. According to plans, the Manwan Hydropower Station will be the second largest hydropower station on the Lancang Jiang. The investment in this station will be 1.05 billion yuan and it will be completed before 1995. The first generator will be put into operation in 1991. In the future, another hydropower station with a capacity of 3.2 million kilowatts, the Xiaowan Hydropower Station, will be built upstream.

A Japanese joint-stock company is negotiating with the Yunnan Provincial Power Bureau on a project to build a 120,000-ton to 200,000-ton cement plant in the western part of Yunnan to provide the Manwan project with cement.

CSO: 4013/120

HYDROPOWER

HONGSHUI HE HYDROPOWER SCHEME TO BE SPEEDED UP

HK180355 Beijing CHINA DAILY in English 18 Apr 85 p 1

[By staff reporter Xu Yuanchao]

[Text] Nanning, Guangxi--A massive hydroelectric scheme on the Hongshui He in south China's Guangxi Zhuang Autonomous Region will add 11,000 megawatts to the nation's electricity generating capacity by the end of the century.

The ambitious scheme will ultimately have 10 dams on the river to create a cascade system powering 10 generating stations. The first dam, the Dahua, was started 9 years ago and began generating electricity in December last year.

The region's Vice Chairman Gan Ku said the construction programme would be speeded up so that six of the stations will be operating by the year 2000.

When all 10 dams are finished the hydroelectric scheme will be able to generate 60 billion kilowatt-hours annually. The whole project calls for a total investment of about 12 billion yuan.

The dams on the Hongshui He will flood nearly 13,000 hectares of farmland and will displace 180,000 residents, said Gan. But the returns from the project will outweigh the land loss.

"The development of hydropower resources on the Hongshui is a strategic measure to relieve the power shortage in south China," said Gan.

Gan said that the Hongshui offered the most ideal conditions for hydropower development in south China.

To help speed the development Gan is to lead an eight-member delegation to the United States where they will study hydroelectric development on the Tennessee River which has many similarities to the 1,050-kilometer Hongshui.

The existing Dahua dam has three of its planned four first-phase generators in operation. Since it began generating last year it has produced 1.18 billion kilowatt-hours of electricity and has earned 50 million yuan.

But there have been problems with the generators installed at the dam and engineers are not certain that the problems have been completely solved.

Dahua plant engineer Gao Hong told CHINA DAILY and other visiting reporters that cracks were found in the rotary blades of the first three generators when technicians examined them last year. One generator had cracks after only 510 hours operation, Gao said.

"Cracks were welded by our own workers," Gao said. "We are still facing a latent threat although the technical problems have been solved.

"We can't make sure, however, that the cracks will not reappear in the future," he added.

Dahua's fourth generator is expected to be installed by August this year to complete the first phase of development with a 400-megawatt capacity. At a later date two more generators will be added.

The 630-million-yuan Dahua project will add 600 megawatts to Guangxi's generating capacity.

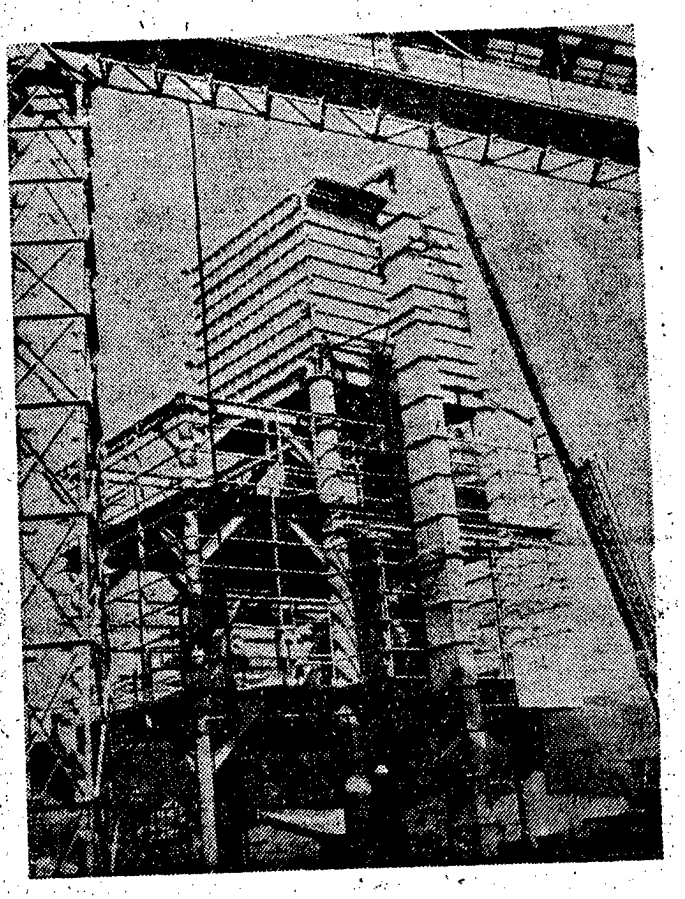
CSO: 4010/131

HYDROPOWER

IMPORTED EQUIPMENT SPEEDS CONSTRUCTION OF SHAXIKOU

Fuzhou FUJIAN RIBAO in Chinese 4 Mar 85 p 2

[Photograph and caption]



In order to accelerate the pace of construction on the Shaxikou [hydro-electric] power station, the Min Jiang Engineering Bureau of the Ministry of Water Resources and Electric Power will import an automated batch plant from Japan.

CSO: 4013/129

HYDROPOWER

BRIEFS

ANHUI SMALL HYDROPOWER--Anhui Province accelerated the construction of small hydropowers in 1984. The province and its prefectures and counties invested over 20 million yuan in the construction of small hydropower stations last year. As of the end of 1984, the province had an installed capacity of 83,000-kw by the small hydropower stations. Five counties, 333 townships, and over 500,000 households in the province mainly rely on power supply by the small hydropower stations. The small hydropower stations generated 120 million kilowatt-hours of electricity in 1984, up 10 percent over the previous year. [Summary] [Hefei ANHUI RIBAO in Chinese 24 Mar 85 p 2 OW]

SICHUAN RESERVOIR SERVES HYDROPOWER--Sichuan is now constructing the Shengzhong reservoir, a large-scale water conservancy engineering project. Since July 1984, some 270 million cubic meters of water have been impounded and water is now being released downstream, assuring a supply for the Zhoujiajing hydropower station, the Panlong 1st and 2nd cascade hydropower stations, the Shengzhong pumping station, the Qingyanzi hydropower station, and the Baozhushi hydropower station in Langzhong County so that they are able to operate normally during the low-water season. It is understood that the reservoir will release some 100 million cubic meters of water over the next 3 months so that the above hydropower stations may increase their output by more than 4.2 million kilowatt-hours. [Text] [Chengdu SICHUAN RIBAO in Chinese 3 Apr 85 p 1]

HUBEI SMALL HYDRO DEVELOPMENT--Hubei's locally run hydropower operations are flourishing: As of the end of February, the province had more than 1,900 small-scale hydroelectric power stations, an average of 27 per county. Hubei has abundant hydraulic resources and in the last few years all areas have paid attention to drumming up enthusiasm for peasant-run small-scale hydropower. According to statistics, the province now has 1,970 such power stations with an installed capacity fo more than 260,000 kilowatts. Among these some two-thirds are run by villages and peasants. Many are built on remote mountain slopes where travel is difficult. They have made both production and living much easier for the peasant population. Statistics also show that the province now has more than 19,000 village and peasant groups served by electricity--72 percent of the total. Last year the province's villages used 520 million kilowatt-hours of electricity, 2.3 times the consumption in 1978. [Text] [Wuhan HUBEI RIBAO in Chinese 6 Apr 85 p 1]

CSO: 4013/130

THERMAL POWER

IMPORTED EQUIPMENT PLAYS MAJOR ROLE IN THERMAL POWER CONSTRUCTION

Beijing GUOJI MAOYI [INTERTRADE] in Chinese No 12, 27 Dec 84 pp 52-53

[Article by Ye Xiaoxia [0673 1420 7209]: "The Role of Foreign Equipment in China's Thermal Power Construction"]

[Text] The development of thermal power in China is mainly based upon the construction of coal-burning power plants. This is determined by China's abundance of coal resources. According to statistics, the verified geologic coal reserves in China is second only to the U.S. and the USSR and ranks third in the world. China's coal resources are not only abundant in quantity, good in quality and complete in variety, and about 45 percent of the total reserve can supply coal for generating power. This provides a very favorable condition for developing coal-burning power plants.

In the 1950's, China's coal-burning power plants were mainly built in areas of power consumption load centers. At that time, China's electric power industry had a weak foundation and it mainly relied on the USSR and some Eastern European countries to provide loans, supply complete sets of equipment and provide technical assistance for the construction of power plants. At that time, many power plants were built in large and medium-sized cities and were heat and power plants built in coordination with industrial users. Some were built for light and textile industry, some for industrial chemical trades and some for metallurgical machine building industry. At the same time, construction also began for power plants solely for power generation. But the construction scale of power plants was small, as the capacity of most of the single generating units were 6,000 and 12,000 kW and a small number of them 25,000 kW.

Beginning from the 1960's, power generating equipment was essentially supplied domestically, although the USSR and some Eastern European countries still supplied some generating units.

After the 1970's, along with the increase in capability to manufacture large generating units and the development of extra high voltage transmission technology, at the same time in order to ease the pressure of transportation and reduce pollution in the cities and at the same time when power plants were built in power consumption load centers, the building of power plants in coal-mining areas has received increasing emphasis by electric power

departments everywhere so that China has successively built large pit-mouth power plants with capacities of several tens of thousands of kilowatts at Huainan and Huaibei in Anhui, Jianzuo in Henan, Hancheng in Shaanxi, Huoxian and Liangziguan in Shanxi, and Laiwu and Shiliquan in Shandong. Most of the generating units of these power plants were produced by China itself. But between 1971 and 1979, China also successively imported three groups of equipment from abroad with a total capacity of 7.21 million kW. The largest power plant built with foreign equipment is the Qinghe Power Plant in Liaoning. Of its 1.1 million kW of generating units, 800,000 kW came from abroad.

At present, the construction of a number of even bigger pit-mouth power plants is being stepped up. Those with a capacity of 1 million kW or above include Datong and Shentou in Shanxi, Xuzhou in Jiangsu, Luohe and Pingwei in Anhui, Zouxian in Shandong, Yuanbaoshan in Inner Mongolia, Yaomeng in Henan, Qinling in Shaanxi, and Douhe in Hebei. Of these, some of the generating units at the Shentou, Xuzhou, Yuanbaoshan, Yaomeng, and Douhe power plants have been completed and have started to generate electricity. Along with the thorough implementation of the policy of opening to the outside world, quite a number of the generating units of the newly constructed power plants were imported foreign technology, including the Douhe, Shentou, Yaomeng, Luohe, Pingwei, Shiheng, and Baogang power plants. For instance, the Douhe Power Plant in Hebei is a modern enterprise with the world's advanced level of technology and a total capacity of 1.55 million kW. Two each of the 125,000-kW and 250,000-kW generating units have been completed and have begun production. The automation level of the generating units are high, and apart from having installed two electronic computers which are capable of 500,000 calculations per second, spectacular new tachnology such as industrial television and microprocessors have been applied. Today, each of its economic indexes ranks among the advanced in the whole country. The Shanghai Baogang Power Plant has already completed the two 350,000-kW generating units provided by Japan. Their technology is advanced, their operations are stable, and they have received good comments.

Moreover, the Yuanbaoshan Power Plant in Inner Mongolia is also a large, modern thermal power plant with a total design capacity of 2.1 million kW. Currently, a first-phase steam turbo generating unit with a single-machine capacity of 300,000 kW imported from France and Switzerland is playing an enormous role in economic results. This steam turbo generator is highly automated. A "steam turbo generator program automation device" and a "steam turbo generator power frequency regulating device" are installed in the generator so that it can work in the best mode of operation. Moreover, the power generator uses water and hydrogen cooling method; the stator is water-cooled and the rotor is hydrogen-cooled, which is safe and reliable and reduces machine wear. Currently the installation engineering of another complete set of 600,000-kW generating unit imported from France and the FRG is being stepped up. The Shentou Power Plant in Shanxi is a single plant with multiple stations. Its No. 1 station has an installed capacity of 1.35 million kW to be constructed in three phases. The 40,000-kW machine and furnace equipment of the second-phase project were made in the USSR and production is respectively underway. Construction of the thrid-phase project is now in full swing. The

four 200,000-kW machine and furnace equipment were imported from Czechoslovakia. The power station uses television monitoring, computer control and other advanced technology, and the degree of automation is high. No. 2 station has a design installed capacity of 2.2 to 2.4 million kW. Its first-phase project will install two 500,000-kW generating units imported from Czechoslovakia which are being prepared for construction. The No. 3 station will begin construction in the future. Huainan Power Plant in Anhui has also adopted the method of a single plant with multiple stations. The newly constructed Luohe and Pingwei Power Stations are controlled by the Huainan General Power Plant. When the first-phase project of the two power stations are completed, the installed capacity of the Huainan general plant will reach 2.4 million kW. Luohe and Pingwei Power Plants are modern. For instance, the two 600,000-kW generating units were produced in cooperation with foreign countries, their engineering design was done by China in cooperation with a U.S. consultancy firm. Their technology is advanced, they are highly automated and their coal-consumption level for power generation is low. Compared to the current coal-consumption level of ordinary power generating units in China, each unit can save 300,000 metric tons of raw coal each year. They demonstrate that China's manufacturing of power generating equipment and power plant construction have entered a new stage. Luohe Power Plant has planned to install four 300,000-kW generating units. Most of the major auxiliary machinery are imported from the U.S. and the FRG. Along with the launching of the engineering construction, the entire project already looks magnificent. Moreover, the two 300,000-kW generating units under construction at Yaomeng Power Plant in Henan were imported from Belgium and their thermal control equipment was manufactured by the U.S., the FRG, and Switzerland. The three major generating, power and furnace machines for the two 300,000-kW generating units of Shiheng Power Plant in Shandong which is under construction were manufacturing technology imported from the U.S. while most of the auxiliary machines were imported from the U.S., the FRG, Sweden, and Japan. When these generating units are completed and go into production, China's thermal power technology will be raised to a new level.

For more than 30 years China has made tremendous achievements in its thermal power construction, whether in design and construction or in equipment manufacturing. On one hand it mainly relied on its own strength to carry out design and construction. China can already mass produce complete sets of thermal power generating equipment of 100,000, 125,000, 200,000, and 300,000 kW, and is beginning to trial manufacture of 600,000-kW generating units. On the other hand, it constantly imports advanced technology and equipment from abroad, which has quickened the development of China's electric power industry and promoted the continual progress of electric power technology.

In view of the needs of modernization, the emphasis of thermal power construction in China will continue in coal-rich Shanxi, Inner Mongolia, Huainan and Anhui, western Henan, southern Shandong, Weibei in Shaanxi, and Liupanshui in Guizhou. Groups of power stations of up to a million or even several million kW will be constructed which will steadily form a strong power center of major power grids. In order to speed up construction, save energy and improve economic results, during the Seventh Five-Year Plan and the next 10 years, new thermal power plants will generally use 200,000- and 300,000-kW generating units and strive to install more generating units of at least

500,000 to 600,000 kW. The original 1,000 10,000-kW small and medium-sized voltage generating units will be gradually replaced by large units or transformed into heat and power plants. In order to satisfy the demands of the four modernizations of the electric power industry, the pace of thermal power construction will be even faster from now on. On the other hand, the future of cooperation with foreign countries will also be brighter.

9586
CSO: 4013/84

THERMAL POWER

COUNTIES TO BUILD SMALL POWER PLANTS IN PILOT PROJECT

OW010903 Beijing XINHUA in English 0643 GMT 1 Apr 85

[Text] Beijing, 1 Apr (XINHUA)--Counties with local coal resources will be encouraged to start thermal power plants as part of the effort to achieve rural electrication, ECONOMIC INFORMATION has reported.

Small thermal power plants each with a generating capacity of 50,000 kilowatts and above will be built in areas which abound in coal.

The Ministry of Water Resources and Electric Power will designate a number of pilot counties for the endeavor, the paper said.

China has already designated 100 counties to go first in achieving rural electrification by starting hydroelectric power projects.

A county will be considered having achieved electrification when it is able to produce enough electricity to basically meet the needs of its industry and the needs of 90 percent of the rural households.

The ministry called on local governments to rely on collectives and peasants to build small thermal power plants, the information added.

CSO: 4010/117

THERMAL POWER

GUANGZHOU TO BUILD 700MW COAL-FIRED PLANT

HK210447 Beijing CHINA DAILY in English 21 May 85 p 2

[Article by staff reporter]

[Text] SHENZHEN--An agreement to build a 700-kilowatt coal-fired power plant--the largest in Guangzhou and the first to be owned and operated solely by the city--was signed recently.

Signatories were the Guangzhou Power Development Corporation and China-American International Engineering Incorporated.

The plant, scheduled to go into full operation by 1989, is designed to alleviate severe power shortages hampering the city's growth.

The agreement was signed in the Shenzhen Special Economic Zone. It was coupled with a separate agreement between the city and the Ministry of Coal for supply of fuel to the plant.

The signing coincided with the formal establishment of China American International Engineering Incorporated. Partners in the joint engineering venture are the China National Coal Development Corporation based in Shenzhen and International Bechtel Incorporated of the United States.

China National Development Corporation handled import-export volume of $359 million in 1984.

The joint venture is beginning feasibility studies on other projects, including an open-pit coal mine in Inner Mongolia, a coal gasification project in Shanghai, and an international building in Beijing.

CSO: 4010/145

THERMAL POWER

BRIEFS

OLD POWER PLANT DEMOLISHED--Beijing, 5 Apr (XINHUA)--Workers here have demolished an old steam power plant by a controlled explosion method to clear the site for a new thermal power plant. A series of explosions ending on 28 March reduced the plant to 50,000 cubic meters of rubble, without damage to a railway line and a residential area 9 meters away, according to ECONOMIC INFORMATION today. Scientists at the Dynamics Institute of the Chinese Academy of Sciences designed the demolition project--so far the biggest in China--affecting buildings with a total floor space of 20,000 square meters, the paper added. The demolished plant was built in 1919, and preparations are now underway to build a thermal power plant with a generating capacity of 600,000 kilowatts. [Text] [Beijing XINHUA in English 0738 GMT 5 Apr 85 OW]

COMPUTER CONTROLS BOILER--Guiyang, 6 May (XINHUA)--A computer now controls the operations of one of the boilers of the thermal power plant in Duyun City, Guizhou Province, according to the industrial department here. This is the first time China has managed to link computerization to this type of heavy industry. Workers can control the boiler's water, heat, air and steam from the terminal of the Chinese-made microcomputer. Before, the workers performed the work manually and had to constantly check various regulatory meters at a 2-meter high, and 1-meter wide console. The computer reduces the amount of labor needed, and cuts investment by half, experts said at a recent appraisal meeting at the plant. They said it provided an example for other thermal power plants and industrial enterprises using similar boilers. The computer program was worked out by the station in cooperation with the provincial engineering college and power research institute. [Text] [Beijing XINHUA in English 0238 GMT 6 May 85]

JINAN THERMAL POWER PLANT--Construction of the Jinan Minghu thermal power plant was formally initiated on 27 March. It is one of the four thermal power plants to be built in Jinan during the Sixth 5-Year Plan period. Installed with three medium-pressure boilers, each with a capacity of 35 tons; two turbogenerating units, one with 3,000 kW and the other with 6,000 kW; and two high-temperature heaters, this power plant requires an investment of 20.44 million yuan. Upon completion in 1987, it will provide 520,000 tons of steam and 42 million kWh of electricity a year. It will replace the present scattered 36 small boilers and 25 low chimneys after being put into operation. [Summary] [Jinan DAZHONG RIBAO in Chinese 29 Mar 85 p 1 SK]

CHANGCHUN UPDATE--Preparations for the construction of the Changchun thermal power plant, one of the state's key projects, began in March 1985. Total investment in this project is 447.8 million yuan. Located in the eastern suburban area of Changchun City, this project will cover an area of 40 hectares. The first-phase project involves the installation of two 200,000-KW generating units. Upon completion and going into operation, this thermal power plant will generate 2.29 billion KWH of electricity and supply 1.49 million kilocalories of heat annually. This project will begin on 1 May 1986. [Summary] [Changchun Jilin Provincial Service in Mandarin 1030 GMT 20 Apr 85 SK]

CSO: 4013/124

COAL

NEW DISCOVERIES RAISE TOTAL RESERVES TO 781.5 BILLION TONS

OW191003 Beijing XINHUA in English 0901 GMT 19 Mar 85

[Text] Beijing, 19 Mar (XINHUA)--New coal deposits amounting to 11.7 billion tons were verified in 1984, bringing the total known coal reserves in China to 781.5 billion tons, according to the latest statistics from the Coal Ministry.

Gao Wanrong, a deputy department director at the ministry, said the largest deposit was located in the Huodong coal field in Shanxi Province; this field now has more than 8.5 billion tons of coking coal deposits.

Gao also said that among other areas of recent discoveries were in and around Shandong Province's Yanzhou mines and Anhui Province's Huainan mines.

CSO: 4010/117

COAL

COAL INDUSTRY SETS TUNNELING RECORD

OW121118 Beijing XINHUA in English 1054 GMT 12 Apr 85

[Text] Beijing, 12 Apr (XINHUA)--Chinese coal miners tunnelled 81,637 meters in the first quarter of the year, an increase of 9 percent over the same period last year and also the highest quarterly record since 1973.

These figures were released today by Lei Jingliang, deputy department director of the Ministry of Coal Industry, who attributed the increase to a spurt in miners' initiative under the responsibility system and the improved management of coal mines.

The first quarter also saw the Borxil mine, in the Inner Mongolia Autonomous Region and with an annual capacity of 450,000 tons, go into operation.

According to Lei, the tunnelling plan for this year is 360,000 meters, which is 40,000 meters more than last year.

CSO: 4010/131

COAL

MINERS PUSH PRODUCTION ABOVE TARGET FIGURES

OW151632 Beijing XINHUA in English 1605 GMT 15 Mar 85

[Text] Beijing 15 March (XINHUA)--China's coal miners cut 125,290,000 tons in the first two months of this year, more than eight million tons above target figures, it was announced here today.

Major coal mines produced an aggregate daily output of 1,100,000 tons an all-time high.

Addressing a national conference here on the industry, Coal Minister Gao Yangwen said: "China's coal production is continuing to grow steadily."

The country produced 772 million tons last year, eight percent more than in 1983, becoming the second largest coal producer in the world, Gao said.

Twenty-one new mines, with a combined annual production capacity of 17,920,000 tons, went into operation last year. The figure was the biggest since 1949.

The construction period for each large new mine averaged 76 months in 1984, 12 months less than in 1983, and 42.6 percent of coal-cutting was mechanized in major mines.

Gao attributed much of the growth to the completion of more local pits.

Collectives and individuals were being encouraged to open coal pits.

China had more than 50,000 such small coal mines in 1984, compared with 20,000 in 1982. They alone produced more than 200 million tons of coal last year.

Gao added that coal accounted for 70 percent of the country's energy supply.

CSO: 4010/121

COAL

COAL MINISTRY OFFICIAL DISCUSSES UPGRADING OF EFFICIENCY

OW272043 Beijing XINHUA in English 1837 GMT 27 May 85

[Text] Beijing, 27 May (XINHUA)--Modern technology is improving efficiency of China's coal mines, and saving vast sums in construction costs, Coal Ministry Deputy General Engineer Chen Bingqiang said in an interview here today.

Last year, state-owned mines cut 395 million tons of coal--17 million more than in 1983--while the industry's 5-million-strong workforce was reduced by 250,000, said Chen.

Chen was here attending the third national conference on science and technology in the coal industry.

Chen said that in the past, output, safety, transport, overstaffing, and low efficiency had posed five big problems for the industry. Until last year, a rise in output had led to a corresponding rise in the number of miners.

But now, the introduction of modern mining methods is freeing many miners to work in the country's growing service sector.

Since the second science and technology conference 2 years ago, ministry specialists had successfully concluded 264 major research programs, involving the design of automated equipment to cut and transport coal, and safety devices to guard against gas, dust and fire.

During this period, 14 mines had been renovated and fully mechanized, and another 32 were being overhauled, said Chen.

And the designers of 36 new pits had revised their plans to incorporate new technology. This would boost the annual capacity from the 70,350,000 tons originally planned to 72,950,000, and would also save more than 200 million yuan on tunneling costs.

Last year, design work was completed on the big Jining No. 3 mine in Shandong Province, which will have an annual capacity of 5 million tons.

It is expected to be in operation within 5 years--compared with the 8 to 10 years a pit of its size would have taken in the past.

CSO: 4010/147

COAL

SHANXI IMPROVES COAL TRANSPORT FACILITIES

OW160820 Beijing XINHUA in English 0755 GMT 16 May 85

[Text] Taiyuan, 15 May (by XINHUA correspondent Wu Xinwen)--China's first double-track, electrified railway for trains carrying up to 10,000 tons is being built from the Datong coal fields in Shanxi to the port of Qinhuangdao in Hebei.

The 630-kilometer line for heavier loads is designed to transport 100 million tons of coal annually out of Shanxi Province, which produces about one-fifth of the nation's output.

Improvement of transport facilities is now the top priority job in the province's economic program, said Yuan Zhende, an official at the Taiyuan-based State Council planning office for the development of the Shanxi energy base.

Yuan said inadequate transport facilities were causing annual losses of several million tons of coal because of spontaneous burning of stockpiled coal.

Shanxi has nearly 3,000 kilometers of railways, six times the figure for the early 1950's. Highways have also been built throughout the province and now have a total length of 27,800 kilometers.

"Even with these improvements, the shortage of transport facilities is becoming increasingly acute," Yuan said.

Between 1949 and 1978, the province's coal output increased by an annual average of 3.29 million tons. The figure shot up to 12 million tons during the 1979-84 period.

In the next decade or more, said Yuan, Shanxi will increase its annual coal output by an average of 15 million tons, reaching 400 million tons by the year 2000.

In 1984, 120 million tons of Shanxi coal were supplied to 26 Chinese provinces and exported to 20 foreign countries.

Major transport projects now under construction include one railway line from Houma in southern Shanxi to Yueshan in Henan Province, and another from Suo County in northern Shanxi to Shijiazhuang in Hebei Province.

In addition, seven existing railways are being doubletracked and electrified, yuan said.

The province will buy 1,400 heavy-duty trucks for highway coal transport in the next 2 years.

Before the end of 1988, 10 highways totalling 515 kilometers will be built to link Shanxi with neighboring provinces.

Peasants are pooling money to build 2,700 kilometers of roads during China's Seventh 5-Year Plan period (1986-90).

They are also being encouraged to start mines to supplement government coal production, Yuan said.

CSO: 4010/141

COAL

PEASANTS SAID TO HAVE 'GREAT FUTURE' IN MINING

OW270812 Beijing XINHUA in English 0747 GMT 27 May 85

[Text] Beijing, 27 May (XINHUA)--Coal mining by Chinese peasants has a great future, said the Ministry of Coal Industry after a recent survey of Shanxi Province.

Shanxi Province cut 178 million tons of coal last year, about a quarter of the national total. The 3,410 rural mines produced 70.65 million tons, nearly as much as the 14 large, modern mines operationg under the Ministry of Coal Industry.

The ministry said that Shanxi had an estimated reserve of 70 billion tons, 7 billion suitable for mining by local peasants for 570 years.

Peasant mining, it said, had saved money for the state, provided jobs and helped ease the energy shortage. The cost per ton cut was only 9.86 yuan, against a provincial average of 20 yuan.

The ministry officials drew attention to the planning and management of small rural mines in other areas.

In view of the country's acute shortage of construction funds, they said, the best way to boost coal production was to encourage peasants to pool their financial resources for mining, though resources must be controlled so as to obviate indiscriminate and wasteful mining.

According to earlier reports by ECONOMIC DAILY, the country has 61,000 rural coal mines, including over 10,000 run by townships. Output topped 216 million tons last year, 27.5 percent of the country's total.

The ministry said that peasants must apply to the provincial coal resources commission for permission to start mines like those in Shanxi. Local authorities must also draw up technical standards and encourage bigger mines to help smaller ones train technicians and adopt safety measures.

It was learned that the Ministry of Geology and Mineral Resources was drafting a law on the management, exploitation and protection of mineral resources.

CSO: 4010/147

COAL

END OF STATE MONOPOLY SPARKS 'COAL RUSH'

HK150727 Beijing CHINA DAILY in English 15 Mar 85 p 1

[By staff reporter Liu Dizhong]

[Text] China is in the grip of a "coal rush" created by the ending of the state monopoly on coal mining which allowed individuals to open pits.

More than 1 million rural residents are mining 50,000 small pits throughout the country. This is almost three times as many as in late 1983 when individuals were given permission to mine coal.

The "coal rush" has helped relieve the nation's severe energy shortage. Last year, the small pits produced 203 million tons of coal, or more than a fourth of the nation's total.

In the first two months of this year, collective groups and individual miners provided more than 30 million tons of coal, up 94 percent over the same period last year.

The figure was revealed yesterday by Chen Yinbin, director of the Energy Bureau under the State Economic Commission, in an interview with CHINA DAILY.

As part of the state effort to encourage more collective and individual investment in small coal mines, the Coal Ministry has made available to them a vast area which has estimated reserves of more than 35 billion tons, Chen said.

Meanwhile, the state has helped establish 69 local prospecting teams across the country to discover more coal resources for rural miners.

Coal produces 70 percent of the nation's energy every year. The total output reached 772 million tons last year, surpassing the Soviet Union's output to rank the second in the world, despite that the energy shortage remains a problem hindering industrial development, particularly in the northeastern and coastal provinces. Some factories in these areas have to stop production 3 or, sometimes, 4 days a week.

However, Chen said, the energy problem has been eased by the coal supply from small mines. For instance, collective and individual miners in Shanxi Province

alone provided 40 million tons of coal last year--more than half of their annual output--to Zhejiang and Jiangsu Provinces.

Last year about 30 percent of coal produced by small pits was sent to coastal provinces. To help coal transportation, the state has earmarked 350 million yuan for building railways connecting the network of small pits which spreads through more than half of the nation's 2,300 counties, Chen said.

Meanwhile, another 26 million yuan was spent last year by the state to establish five transport teams, each with 100 imported trucks.

But, he said, overstocking of coal produced in small pits was still a headache. Pithead stocks reached 47 million tons by the end of last year. The figure has been rising in the past 2 months.

The prosperous small mines have also fuelled a boom in rural industry and collective and individual undertakings, such as small ironworks, small power stations and factories producing cement, bricks and other building materials.

Since last year, the state started to provide annual loans of 200 million yuan to help rural people open new pits or expand existing ones. The figure can be expected to increase during the Seventh Five-Year Plan period (1986-1990), Chen said.

Efforts will be focused on increasing the number of small pits rather than building state-owned major mines in areas with rich coal reserves such as Shanxi, Shaanxi, Henan, Gansu, and Guizhou Provinces. The main task in these areas is to improve their transportation to move the coal more quickly, he said.

CSO: 4010/117

COAL

GUIZHOU'S PEASANT-RUN MINES GROWING RAPIDLY

OW180851 Beijing XINHUA in English 0645 GMT 18 May 85

[Text] Guiyang, 18 May (XINHUA)--Small, peasant-run coal mines are multiplying fast in Guizhou Province thanks to government encouragement, a provincial official said here today.

Their number has soared 70 percent to 11,000 over the past two years. Over 142,000 peasants are employed.

More mines will be opened this year by rural township governments, villages, groups of peasants, and individuals.

Last year, peasant-run mines produced nearly 13 million tons--62 percent of the province's total. Their output was worth 305 million yuan, or a quarter of the total rural industrial production value.

Peasant-run mines are helped by the government with information, technology, loans and transport.

Gaozhai village in the suburbs of the provincial capital of Guiyang has become Guizhou's first village with an annual per-capita income of 1,000 yuan. The village's 106 households operate 15 mines, and 85 percent of its workforce is engaged in coal production.

Guizhou's coal reserves are verified at 49 billion tons, placing it fourth in China after Shanxi, Inner Mongolia and Shaanxi.

The province is set to become the largest coal production center in southwest China by the end of this century.

CSO: 4010/145

COAL

SHANXI ENCOURAGES PEASANTS TO RUN COAL MINES

OW091615 Beijing XINHUA in English 1449 GMT 9 May 85

[Text] Taiyuan, 9 May (by XINHUA correspondent Wu Xinwen)--Peasants in Shanxi Province are producing almost as much coal as large, modern state-owned mines.

Shanxi, in the heartland of China, provides nearly one-fifth of the nation's coal output. Encouragement to peasants to go into mining is now a national policy to alleviate China's chronic coal shortage, according to a provincial government report reaching XINHUA today.

Last year, the 3,410 rural mines in Shanxi produced 70.65 million tons, nearly as much as the 14 large, modern mines operating under the Ministry of Coal Industry, the report says.

Peasants in 79 of Shanxi's 101 counties have started mines. Twenty-three counties are producing more than 1 million tons a year.

As the country suffers from acute shortages of construction funds, the report says, the best way to boost coal production is to encourage peasants to pool their financial resources for mining.

Between 1980 and 1983, Shanxi peasants received low-interest loans of 287 million yuan to increase the annual output of their mines by about 40 million tons.

The state invested 2.57 billion yuan in state-owned mines during the same period. The result: an increase in annual output of 23.8 million tons.

Low-interest government loans for rural mining came to 329 million yuan in 1984, the report says.

The state operates large, modern mines, while peasants are encouraged to work scattered and shallow resources, where mechanized, large-scale mining is impossible.

The provincial government has designated areas with coal reserves amounting to 15 billion tons around seven major coalfields for peasant mining, the report says.

Mining, it says, now accounts for up to 51 percent of peasant income in coal-producing counties.

Peasants must apply to the provincial coal resources commission for permission to start mines.

The commission sees to it that small mines do not affect large-scale production by state-owned mines.

Peasant mines can buy equipment and technology from state mines at preferential prices, the report continues. They can also count on their state-owned counterparts for personnel training, the report says.

CSO: 4010/138

COAL

LOCAL PIT OUTPUT EXPECTED TO TOP 450 MILLION TONS BY 1990

Beijing ZHONGGUO MEITAN BAO in Chinese 15 Aug 84 p 1

[Text] Since the founding of the new China, the output of local coal mines at every level has increaed 38.5-fold, from the 8,904,000 tons of 1949 to the 351,412,000 tons of 1983, now equalling 49.18 percent of the total coal output in China, or one-half of the nation's coal miracle. Especially since the Third Plenum of the Eleventh Party Congress there has been progress made in freeing up policies and stimulating the economy; local coal mines have developed even faster. From 180 to 1983 the average increase was over 18 million tons. The increase last year (1983) over the previous year was 35 million tons, the rate of increase was 11.1 percent.

The quality of local coal mines has increased as well. Of 2,512 local state run coal pits, 53.4 percent yield over 150,000 tons per year. Of the total 46,000 commune and collective-run coal pits, 1,600 yield over 30,000 tons per year; the scale is 76,010,000 tons. The "four small items" (winches, pumps, blowers, and mine lamps) have been installed in over 4,500 locations. Over 4,000 locations have put the "four eliminations" (eliminate one-exit mine pits, natural ventilation, open-flame and sparking illumination, open-flame and sparking blasting fuses) into effect. They are beginning to be transformed into small-scale normal production mines. In addition, local mines have a considerable capacity for export, shipping as much as 108,720,000 tons a year by rail alone.

The overwhelming majority of local coal mines got their start by making do with what was available, relying on what they could produce and accumulate to pay for technical upgrading, growing from small to large, going from local to foreign, from irregular production methods to regular production methods. They have followed a path for coal industry development which is suited to the national conditions present in China. Local mines find materials locally, provide their own labor, do not build elaborate temporary structures, reducing investment required to put a new mine in operation, and producing results quicker. In the ten years from 1971 to 1980, local state run mines built 485 pairs of new pits, at an average investment of 47 yuan per ton. Communal and collective coal mines require no state investment, and last year produced altogether 170,060,000 tons, 48.4 percent of the national total.

Local coal mine management is flexible, so they are able to exploit everything within the boundaries of a coal field, and exploit the pillars and leftovers

that a large mine would not be able to exploit. According to statistics from Shanxi, Henan and Shandong, 72 percent of the total coal available comes from exploiting leftovers and outside coal in local mines. In the Jinhua area of Zhejiang, and elsewhere, stone coal and other low heat value coal is exploited, and a good utilization of a resource is made.

Local coal mines are numerous and widespread. They are found in 1,200 counties and 28 provinces or areas. They are causing China's coal industry to move toward rationalization. There were local coal mines in 20 provinces that exceeded 5 million tons last year. In 10 provinces there were mines exceeding 10 million tons. The largest, in Shanxi, hit 83.17 million tons. Through the development of local coal, the coal-poor southern provinces have steadily increased their self-sufficiency in coal. Last year those 9 provinces' local mines produced 71.41 million tons, or 62 percent of the total for those provinces. Hunan and Jiangxi are already basically self-sufficient.

Local coal mines are effective in spurring on the development of local industries such as electrical power, chemical fertilizer, construction material and machine building, they stimulate the local economy, raise the people's standard of living, arouse important actions. According to national surveys, for every 80,000 tons of local coal that is used, 100 million yuan of industrial output value is created, bringing in 20 million yuan in revenue to the state. Coal left over from supplying local needs can be used to fill some of the gaps left in the national unified distribution scheme; in 1983 67.4 million tons of local coal were brought into the national unified distribution. The provinces, localities and counties also used 152.33 million tons, ameliorating our national energy shortage. This lessens the pressure on the unified distribution mines and the burden on the railroads.

Local coal mines have a solid footing in scientific study, coal mechanization, geological surveying, and construction and technical training. These conditions had to be met to increase the acceleration of development. According to long range plans, local coal mine production is to increase by over 20 million tons per year, to reach 450 million tons by 1990, with limitless prospects.

12663
CSO: 4013/231

COAL

NATION'S LOCAL MINES PRODUCTIVE, BUT PROBLEMS ABOUND

OW140302 Beijing XINHUA in English 0206 GMT 14 May 85

[Text] Beijing, 14 May (XINHUA)--The output from China's 61,000 privately or collectively run coal mines topped 216 million tons last year, an increase of 46 million tons over 1983, according to ECONOMIC DAILY.

This represented 27.5 percent of the country's entire coal production.

Most of the coal--170 million tons--was dug by the 9,100 township mines which have an annual capacity of 10,000 tons or more.

Of these, there are now more than 3,000 mines with a capacity of more than 30,000 tons a year, and they produced a total of 109 million tons last year.

However, poor mining equipment and safety conditions had been found at many mines, the paper reported. This made it necessary to strengthen technical reform and introduce scientific management.

Rich reserves of coal, iron, nonferrous metals, and some rare metals across the country have given township mines a bright future, the paper added.

CSO: 4010/138

COAL

IMPORTED EQUIPMENT PLAYS MAJOR ROLE IN SHANXI DEVELOPMENT PLANS

OW031610 Beijing XINHUA in English 1441 GMT 3 May 85

[Text] Taiyuan 3 May (by XINHUA correspondent Wu Xinwen)--More than one-third of the coal mining equipment imported by China is used in Shanxi Province, which produces nearly one-fifth of the nation's coal.

Shanxi mines are now using 96 coal extraction combines, 57 of which were imported from Poland, the United States, and Federal Germany.

Negotiations are now underway to import more combines and other equipment from these countries, said Yuan Zhende at the State Council Office for the Development of the Shanxi Energy Base.

In an interview with XINHUA today, Yuan said the government is paying a great deal of attention to the development of coal mining in Shanxi, as the province is expected to produce anywhere from 360 to 400 million tons of coal a year, one-third of the nation's total, by the turn of the century. Output in 1984 was 187 million tons.

Development of Shanxi's coal industry is of vital importance to the growth of the national economy, said Yuan, adding that coal accounts for 70 percent of the nation's energy consumption.

He said the upgrading of coal mining equipment in Shanxi was part of an ambitious plan to build a large coal and heavy chemical industrial base within this century.

With Shanxi as the center, the base, with an area of 1.17 million square kilometers and verified reserves of 500 billion tons--70 percent of the nation's total--also includes parts of Inner Mongolia, Henan, Shaanxi, and Ningxia.

Attention will be focused on development of Shanxi during the Seventh Five-Year Plan period (1986-90). Other parts of the base will be developed between 1991 and 2000.

"To meet this target," Yuan said, "we will have to rely on our own efforts but also make good use of foreign investment and technology."

State investment in Shanxi's coal mines have increased at an annual rate of 36.5 percent for the 6 years beginning in 1979, reaching 850 million yuan in 1984.

Twenty-two pairs of shafts are now under construction, including five designed to produce 3 million tons annually. When completed in 1992, yuan said, these will produce 43.75 million tons a year.

Another 86 pairs with an annual production capacity of 55 million tons have been put into operation during the last 6 years.

At the Gujiao mining area in southeastern Shanxi, he said, Swedish technicians are helping to install mining equipment imported from their country.

Geologists from the United States are prospecting at the Pingshuo mining area.

Four coal mines funded by a low-interest loan from Japan have already started operation. Shanxi Province has also entered into a number of compensation trade coal mining projects with Romania and Yugoslavia.

At the Guandi mining area on the outskirts of Taiyuan, coal extraction combines imported from Federal Germany are each bringing out 3,600 tons of coal a day.

CSO: 4010/137

COAL

ALMOST HALF OF STATE-RUN MINES NOW MECHANIZED

OW050817 Beijing XINHUA in English 0724 GMT 5 May 85

[Text] Beijing, 5 May (XINHUA) -- Over 44 percent of the large and medium-sized state-owned coal mines in China have been mechanized, according to vice-minister of the coal industry Ye Qing.

Slightly more than one-fifth of these mines are now using comprehensive sets of coal cutting equipment, he added.

Such state-run mines account for over half of China's annual coal production.

Addressing a national conference on the mechanization of coal mining now in session here, Ye said the most successful of these mines is the Wangzhuang colliery in Shanxi Province which has been completely mechanized.

In this colliery, with an annual production capacity of 1.2 million tons, he said, 82.96 percent of the coal is being mined by means of comprehensive sets of equipment.

Ye further announced that, thanks to mechanization and the responsibility system, mines under his ministry produced 133.28 million tons of coal in the first 4 months of this year, 5.1 million tons above the target.

In 1984, these mines produced 394 million tons of coal, of which over 42 percent was cut by machinery and half of this was recovered by coal combines, both slightly more than in the preceding year.

China produced a total of 772 million tons of coal last year. A substantial part of it was mined by collieries run by local authorities and collective enterprises.

More than half of the 92 coal mining administrations under his ministry, Ye said, have been mechanized to some extent. They own 260 sets of comprehensive mining equipment.

Some of the mining machines are Chinese-made and the best of them compare favorably with those built in other countries, Ye said.

To step up mechanization of the industry, the vice-minister said, China expects to import from Poland this year 19 sets of comprehensive equipment, including new types of hydraulic supports, coal cutters, and chain conveyors.

However, he said, China should lay emphasis on developing its own coal mining equipment while importing foreign machinery.

He urged all coal administrations to pay greater attention to economic returns, training of technical personnel, and developing new equipment so as to increase coal production in the most cost-effective way.

The 5-day conference is scheduled to end on 7 May.

CSO: 4010/134

COAL

HUOLINHE MINES WILL BE BOON TO REGION'S ECONOMY

SK060602 Hohhot NEIMENGGU RIBAO in Chinese 21 Apr 85 p 1

[Excerpt] After inspecting the Huolinhe mining area on 14 April, Bu He, chairman of the autonomous region, said: Compared with other provinces and regions of the country, Nei Monggol's economy is backward. When the Huolinhe open-cut mine--a key state construction project--is completed and goes into operation, the coal, power, and chemical industries will develop simultaneously. This will greatly promote the economy of the minority nationalities, and has an extremely important significance.

On the prospects for developing the Huolinhe coal mine, Bu He pointed out: In view of the hydrologic and geographical conditions of the coal mine, it is suitable to build power stations at the mouth of the coal pits and exercise joint coal and power operations if we use the brown coal of the Huolinhe mine. Turning coal into energy for power on the spot will, on the one hand, relieve strained transportation and on the other, offset the losses resulting from the high cost and low price of coal with the increased income from the power industry. This will at least help maintain a balance between profit and loss, and therefore would be beneficial. The economic development in the Huolinhe area should be focused on coal. Efforts should be made to do a good job in the multi-purpose utilization of brown coal, and turn unitary production into joint operation of production and business. In addition to the coal mine, we should build power stations, chemical industrial plants, and other plants with coal as the major raw material in order to make full use of brown coal.

In constructing this coal mine, we welcome all competent parties. All fields should support this principle. In constructing such a large-scale project, we should map out long-term plans, and then take one step whenever we are sure of its success, and see to it that every project we carry out is a success. We should develop the projects for both production and the people's lives simultaneously, and attend to tertiary industry while carrying out urban construction.

CSO: 4013/134

COAL

GAO YANGWEN PRAISES ACHIEVEMENTS OF NATION'S COAL INDUSTRY

Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese No 10, Oct 84 pp 2-3

[Article by Gao Yangwen [7559 2254 2529], Minister, Ministry of Coal Industry]

[Text] On the eve of China's jubilant celebration of the 35th anniversary of the founding of the PRC, I want to take the opportunity afforded by MEITAN KEXUE JISHU to cordially salute the hard-working technicians and staff at the forefront of China's coal industry.

Since the founding of the PRC, great achievements have been made in all areas of the coal industry. Geological prospecting has revealed coal reserves in excess of 700 billion tons. In basic construction, 1,834 mines have been opened with a capacity of 450 million tons; 82 mining regions producing in excess of 1 million tons have been opened, and 11 of these produce more than 10 million tons annually. Raw coal production reached 715 million tons in 1983, which is 22 times greater than in 1949, and China has jumped from ninth to third place among the coal-producing nations of the world. Great progress has also been made in the use of processing technology, in mechanization, etc.

The great advances in the coal industry are intimately related to developments in science and technology. During the past 35 years China's coal technicians and workers have applied their intelligence and talent in a highly responsible manner toward contributing to the development of China's coal industry, and many gratifying results have been achieved through their pioneering efforts which embrace the entire coal industry. As an example, we may cite progress in research on the longwall method, which has replaced China's outmoded coal mining technology and greatly increased productivity and the rate of recovery of our coal resources. As for shaft construction, particular progress has been made in shaft-sinking methods, where breakthroughs now permit the mining of deeply buried coal deposits or deposits lying below layers of quicksand. Mine capacity has been increased from the small-to-moderate category to in excess of three to four million tons. Success in developing comprehensive mining equipment and the use of batch processing have stimulated the mechanization of China's excavating equipment. The effect of all of these advances has been to promote the modernization of the coal industry and to provide a foundation and create conditions for Chinese production to reach 1.2 billion tons by the end of this century. However, we must not overlook the fact that

R&D remains quite backward in the coal industry. Manual work methods are still employed in coal production and mine construction, and 60 percent of excavation sites still employ hole digging and blasting. The development of equipment for ensuring mine safety is another weak area in which China remains unable to assume the initiative. Other areas also remain in which the level of Chinese equipment is low, with the result that large amounts of manpower are required to mine the coal, efficiency is low, and the accident rate is high. This state of affairs is quite incongruous, given the magnitude of China's principal coal reserves and the difficulty of the tasks which lie ahead.

Research is an important force which drives production. A review of history shows that all advances in human society have received important stimulus from science and technology. Examples include the use of fire, the development of iron-working, and the invention of the steam engine, all of which ushered in new cultural and social eras. Today, developments in science and technology are coming at a faster pace, important new discoveries are continually being made, and human society is advancing more rapidly. In this new age, the Party and the Nation have adopted the slogan of reliance on science and technology for the vigorous development of the Chinese economy; such a policy is indeed correct and foresighted. This new attitude is now being inculcated among the masses, and a new technological revolution is taking shape throughout China. With each passing day, science and research are extending deeper into industry, agriculture, and all areas at the forefront of development. Given this situation, if coal mining technology does not advance, the initially backward state of coal technology will become even more backward by comparison. This will not only jeopardize our strategic goals for multiplying production but will also make it impossible to improve mining safety and reform the entire coal industry. In other words, vigorous development of the coal industry will also have to rely on progress in science and technology. This circumstance must be soberly recognized, particularly by the technical workers among the vast workforce employed in the coal industry; these technicians must mobilize quickly, face the problems squarely, and bring coal-related R&D to a new level of advancement.

We must focus our efforts on the strategic goal of producing 1.2 billion tons of coal by the end of this century, carry out the "five transformations," develop research, and make strenuous efforts to apply new technology. Computers should be used as soon as possible to assist in all aspects of mine production and construction. We must actively develop methods for integrating mechanical, electrical, and measurement components into single systems and use them as quickly as possible in equipment for mining, excavating, transporting, and hoisting coal, and in rescue operations in areas where mining is dangerous. Methods for communicating in mines must be vigorously pursued, and new types of materials must become more generally used. In summary, great changes in the techniques used by the coal industry will have to take place in the near future.

The vast workforce in the coal industry will need to set its sights high and work with determination and a willingness to sacrifice; closer links with coal scientists will need to be forged; assiduous study will be required, and no effort must be spared in the struggle to advance the state of China's coal mining technology.

We look forward to even greater future achievements in coal mining technology and working conditions, and we anticipate that the Journal of Coal and Science Technology will stimulate new progress in the development of industrial coal technology by making the fruits of new research known to the public.

12617
CSO: 4013/60

COAL

ROLE OF R&D HAVING IMPACT THROUGHOUT ENTIRE INDUSTRY

Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese No 10, Oct 84, pp 3-8

[Article by Fan Weitang [5400 4850 0781], Director, Coal Science Research Institute]

[Text] I. Successes and Effectiveness

With the development of the coal industry subsequent to the founding of the PRC, coal research in China developed gradually from its initial low level to its present flourishing state. With a workforce of 7,000 people, the capabilities of coal research are now considerable. Since the founding of the Coal Research Institute in 1957, nearly 1,200 research projects have been completed, of which 110 were awarded National Science Congress prizes (there were 5 special prizes, 27 first prizes, and 70 second prizes). Water flushing and 115 rosin unsaturated resin bolt cartridges were awarded National Invention prizes. Many of these innovations are widely used in production and construction; they have proved to be of enormous economic benefit and have contributed greatly to the development of the coal industry.

1. Coal Field Geology and Exploration

(a) Prospecting for Coal

Much research has been done on the conditions for coal formation and on the distribution of coal resources. Coal deposits in different strata have been distinguished and compared, palaeological and sedimentary models have been used to analyze coal and coal-series facies, and the factors which control the structure of the deposits have been studied. On the basis of these studies, coal-field prospecting charts have been drawn up for all of China and maps have been compiled which describe the geological conditions of coal fields, the structural systems, the distribution of different coals, the palaeological features most important in coal formation, etc. This work has provided a rational scientific basis for coal prospecting and development.

(b) Coal Field Prospecting Techniques

The analog magnetic-tape seismographs continue to undergo development and are finding wide application; digital seismographs have also been developed.

Electromagnetic waves are used for underground probing, and a digital device is now being developed for locating underground deposits by measuring the frequency of the reflected signals. A series of synthetic diamond and hard-alloy bits are now available for drilling through hard rock and have greatly speeded up the coal drilling process. Computers are widely employed to process all types of data obtained from physical prospecting. The interpretation of geological features using remote sensing devices and the processing of data taken from images are becoming effective tools in research on finding coal.

(c) Methods for Avoiding Karst Water

The hydrological conditions in many of China's karst coal mines are complex and the mines are subject to flooding. The amount of karst water and its sources, flow, and drainage and the relationship between coal extraction and flooding have been studied. Preliminary scientifically based methods for assessing and controlling the karst water problem have been developed which are technologically innovative and effective in coal production.

2. Mine Shaft Construction

(a) Construction of Vertical Shafts

Two hundred and three shafts have been dug through thick topsoil and layers of quicksand by the freezing shaft-sinking technique; the largest shaft is 415 meters deep. After numerous measurements and much theoretical analysis, China has basically mastered the freezing and walling techniques; we have the required refrigeration machinery, drills for boring frozen holes, and inclinometers, correcting drills, and computational methods are available for the rational specification of shaft walls. Thirty-three shafts have been dug through thick topsoil and layers of quicksand by the boring method. The largest shaft is 508 meters deep and the maximum diameter is 6.8 meters. The problem of increasing the lifetime of the mud bits and cutting tools has essentially been solved, and materials and techniques for stopping water leaks at pregrouted workfaces and surface locations are well in hand. The development and application of special shaft-sinking techniques have contributed greatly to shaft construction in eastern and northern China.

Large mechanized drilling and blasting equipment built up from rock grabbers of capacity 0.4-0.6 m^3 are widely used to sink vertical shafts. This equipment has increased the average monthly tunneling distance by 50 percent, and shafts 104 meters deep can now be dug in a month.

(b) Drivage

Tunnelling machines with bores of diameter of 3 meters have been developed which can dig up to 300 meters of tunnels per month; the direction of tunneling can be controlled, and the lifetime of the cutting tools has been extended. Combines consisting of loading cars equipped with rakes, shovels, rock-grabbing claws, side-loading cars, or loaders equipped with drills are starting to find use in various mining situations where drilling and blasting techniques are used for tunnel driving. Self-contained motorized tunnel-excavating equipment suitable for small local coal mines is also starting to appear. Long-hole

smooth blasting and bolt-and-spray techniques are widely used (eight thousand kilometers of tunnels are now supported by this technique), and methods have been developed for monitoring the rock resilience, airborne dust concentrations, and structural weaknesses.

(c) Cutting Coal and Semicoal Tunnels

Machines for boring tunnels in coal and semicoal deposits are starting to appear. These machines include the EM-30 and EMLA equipment for driving drifts with a small cross sectional area. The EL-90, which can also bore cylindrical tunnels, is suitable for horizontal tunnels with relatively large cross-sections. Metal support frames and their associated equipment are now available.

3. Coal Mining

(a) Supports

On the basis of measurements and theoretical analyses of rock pressure at 350 workfaces mined by the longwall method, a procedure has been developed for classifying roof strengths in gently sloping coal seams and for selecting appropriate supports.

Immediate roofs are classified into four types, based on a comprehensive analysis of the ability of the rock to withstand pressure, the thickness of the seams, and other factors which influence the overall strength. The classifications are: unstable, moderately stable, stable, and solid. Old roofs are classified into four types, depending on the distance moved when a pressure is first applied and on the ratio of the area of the immediate roof to the height of the mining chamber. Appropriate roof management methods have been established for the different types of roofs, and criteria are available for choosing the strength and the type of the support.

On-site research has been done on the use of water sprays to soften solid roofs, on methods for forcing water to percolate through the roofs, and on the effects of rock pressure when high-strength supports are used. Technically and economically, the results have been excellent.

With the development of metal pillars, roof beams, hydraulic poles and supports, the amount of wood consumed in tunnel-supporting frames has dropped from more than 200 cubic meters per 10,000 tons of coal in the 1960's to less than 80 cubic meters.

(b) Mining Beneath Buildings, Railroads, and Bodies of Water

Studies have been underway for some time concerning the feasibility of coal mining under buildings, railroads, and bodies of water (the "three unders" or U^3 mining), and on surface transport methods. Roughly 600 million tons of coal have been mined in this way. Collapse caused by overburden has been better understood on the basis of the experience gained in 800 underwater workfaces in coal mines. A complete set of equations suitable for different types of overburden has been derived for calculating collapse heights and the

heights of water-bearing crevices. A "Method for analyzing seam structure" has been proposed for fully assessing the feasibility and safety of underwater mining. Mining from under railroads has also proven successful where mining depths and thickness are small, and in mountain areas where the steeply inclined coal seams make normal mining difficult. On the basis of extensive measurements, critical surface deformation values have been proposed which correspond to different degrees of damage to various types of structures; these criteria are used to decide when coal mining underneath buildings is feasible. The basic laws and equations governing surface transport have now been found after much work. Because computers can calculate the degree of surface settling at any arbitrary point above the mined section for arbitrary surface conditions, we now have a scientific basis for drawing up guidelines for U^3 mining.

(c) The Mechanization of Coal Mining

High-grade general mining and comprehensive mining equipment have been developed during the last decade. The high-grade general mining equipment, with a maximum yearly yield of 500,000 tons, has yielded obvious technical and economic benefits. The DY mining combines have been found in tests to operate continuously for 600 hours at full load, and their reliability has been greatly improved. China is beginning to manufacture comprehensive mining equipment capable of mining coal from inclined seams between 1.3 and 3.5 meters thick. The MD-150 coal mining machine is being used as the basis in designing a series of comprehensive Chinese mining equipment capable of producing more than 90,000 tons of coal monthly. The more than 60 of these comprehensive coal mining machines now in use produce some 17 million tons of coal annually; the average productivity per workface is 11 tons. The high-pressure emulsifying fluid pump stations employed in the hydraulic support equipment have been found in tests to operate under full load for 3,000 hours and are as good as any in the world. Technogically advanced, highly reliable, versatile, well-configured, and inexpensive comprehensive mining equipment has been developed quite recently which is adapted to China's needs and economy (the equipment costs 40 percent less than before) and which has already demonstrated outstanding technological and economic results.

(d) Coal Mining Using Hydraulic Power

Large hydraulically powered jet sprays are already in general use in some mining locations. A large hydraulic jet sprayer capable of developing a pressure of 200 kg/cm^2 was successfully developed in the 1970's for knocking coal out of the harder deposits. Both large- ($\leq$ 50 mm) and small-diameter ($\leq$ 3-6 mm) water pumps were developed for hoisting coal and have played a key role in transporting and lifting coal slurry. Mechanized equipment is used to remove the water at the surface and ensure that the solid waste content of the efflux conforms to national environmental standards so that the water can be recycled.

4. Coal Mine Safety

The central task in coal mining safety is to control gas levels and prevent coal dust explosions. We have made great progress in developing methods for

improving ventilation, eliminating gas, reducing the concentration of coal dust and eliminating sources of ignition, and safety monitoring methods and protective equipment have been developed.

(a) Elimination of Gas

Gas concentrations are high in almost all of China's coal mines. At present, 300 million cubic meters of gas are expelled each year from 102 mines. Techniques for efficiently ventilating each coal seam and eliminating gas are now well in hand. Hydraulic channel boring machines can increase the gas efflux from coal seams by three to five times and increase the gas discharge out of adjacent seams by more than 70 percent. Good results in gas expulsion from tunnels have been obtained in the Yangquan mining region.

(b) Preventing Coal Slides and Gas Bursts

In multilevel mines where the uncontrolled release of coal and gas is a hazard, selective expulsion of gas while mining proceeds from the upper to the lower seams has proved effective in preventing sudden gas eruptions and has extended the effective safety margin in released seams to floor depths up to 80 meters. We have established comprehensive guidelines for predicting coal and gas bursts and have developed methods for determining gas concentrations and assessing the sources of gas. The jetting method is used to expose rock openings, drive coal tunnels, and recover coal in order to greatly reduce the hazard associated with uncontrolled coal and gas release.

(c) Prevention of Coal Dust Explosions

The increased use of the coal pillar spraying method has reduced the amount of coal dust at the workfaces by 60-80 percent. Passive water curtains are beginning to be used in order to effectively control the concentration and spread of coal dust. Many types of dust filtering equipment are employed to keep the dust concentration below 10 mg/m^3 in the drivage tunnels. Individual filters are used in some cases (electric dust-filtering caps, gauze masks, forced-air respirators).

(d) Fire Prevention

A method based on an analysis of self-combustion mechanisms has been developed for classifying coals according to their tendency to ignite spontaneously. A method has been found for on-site monitoring of self-combustion hazards which is based on measuring the absolute concentration of CO in circulating air. Infrared beam analyzers continuously monitor hot spots and flame retardants are used. Fire extinguishing by dry powder, foam, and inert gas fire extinguishers has proved effective, as has the use of ventilation at uniform pressure in order to prevent fires. In addition, there has been considerable success in developing systems for monitoring the safety of mines and blasting and hoisting equipment, making the equipment safer, and avoiding surface shocks.

5. Coal Grading and Processing

(a) Research on Coal Quality

Humic coals have been systematically studied by chemical and petrographic methods, and their physico-chemical and processing characteristics have been determined. These studies have yielded insight into the laws by which the grades of coal change and provided information about the characteristics of coal deposits laid down during each principal coal-forming epoch in individual regions of China. These results are now contained in a data bank on coal resources from which information can be retrieved by computer. Only 4-5 minutes is needed to analytically determine the sulfur or water content of coal by electrical measurements (coulombmetrically). The steps in the process for measuring the heat evolved from coals have been greatly simplified through the use of new equations which correct for cooling.

(b) Coal Washing

Jiggers with air chambers below coal screens of area 24 m^2 and 35 m^2 have been developed. Centrifugal agitators are helpful in coal selection and in the desulfurization and recovery of coal brass. Because of the great difficulties in selecting coal, flotation separators of volume 6, 8, or 12 m^3, equipped with mechanical agitators, and jet-spray flotation separators of volume 4.8 m^3 are widely used in coal production. Permanent-magnet separators operating at high magnetic fields, swirling agitators capable of separating two or three components, and selectors with vertical wheels have been developed for heavy-media separation. The separation efficiency reaches 99 percent when vertical-wheel separators are used to eliminate waste rock. Heavy-media swirling devices capable of selecting three components have simplified the separation process, reduced electricity consumption, and decreased the cost of coal-processing plants. Because swirling-water separators can separate particles as small as 0.15 mm, less coal slurry is required in the flotation system. Irregular folding-band filters and a 500 m^2 automatic pressure filter have been developed; they are being used in some coal selection plants in closed-loop water systems to wash coal and recover it from the slurry yard. Some coal-washing plants are now centrally controlled and have automated single-unit systems. Instruments for measuring ash by isotope analysis and automatic batching devices for controlling mixture compositions are used in coal-washing plants.

(c) Coking, Gasification, and Liquefaction of Coal

China's coking plants process a high proportion of viscous, highly volatile, easily cracked material. Extensive studies have been done on gas coal coking processes aimed at increasing the proportion of gas coal in the mixing chamber. Coke grade has been improved by prepulverizing or ramming the charge in the coking furnace or by adding coking powder.

A key task in gasification research is to decide which coals are suitable for processing by the pressurized gasification technique used in large cities and which are suitable for the two-step gasification technique used in small and

medium-sized cities and in mining regions. Several effective catalysts have been found for coal gasification; their catalytic activity is far superior to the arsenic catalysts now in general use.

Research on coal liquefaction involves work on using solvents to extract brown, flame, and high-sulfur coals in high-pressure cauldrons and on their liquefaction by addition of hydrogen. Good results have been obtained in experiments on liquefying high-sulfur coal from Yanzhou by adding hydrogen in small-scale continuous liquefying equipment. We have cooperated with Japan's C. Ito & Co., Ltd. and the U.S. Hydrocarbon Company in small-scale tests of the hydrogenous coal (H-coal) method in the liquefaction of high-sulfur Yanzhou coal, and very good results were obtained. Preliminary feasibility tests revealed that the construction of a coal liquefaction plant capable of processing 10,000 tons of raw coal might be economically beneficial as China builds up its capabilities.

(d) Coal Burning

China has rich reserves of coal which have a low calorific (combustion) value; the full exploitation of this coal will not only ease the current fuel scarcity but can also turn a disadvantage into an asset. We have taken the first steps toward developing and applying the boiling combustion technique, which has been found to be highly economical and less polluting.

After some 20 years of hard work, the Coal Science Research Institute has come up with several advanced experimental techniques — a shearer test site, powered support and valve lab, airfreight carrier (AFC) lab, cutting tools lab, dust test gallery, liquefaction lab, gasification lab, long-distance pipeline transportation lab. Several tool components and new products (e.g., cycloidal motors and drilling machines which extract and eliminate gas) have reached the world advanced level. The Research Institute of Coal Science has research collaboration agreements with the United States, Japan, Great Britain, West Germany, France, Poland, Spain, Hungary, Canada, and other countries. Several projects in this joint research effort have already yielded significant advances.

II. Main Tasks and Key Areas Targeted for Advances

1. Development Objectives

In order to realize the strategic objectives of the development of the coal industry, we must make full use of the opportunities provided by the technological revolution and strenuously apply the new techniques to the equipping of the coal industry. Before 1990, units specializing in coal research will provide the crucial technical means for dealing with the ten areas of coal mining and utilization for which solutions are urgently needed — these areas include constructing mines in newly developed areas, transforming old mines, ensuring mining safety, developing small coal mines, making comprehensive use of coal resources, etc. The goal is to fully master the advanced technology which was widely used by the leading coal-mining countries of the world in the 1970's and early 1980's to produce coal and construct mines; to master some economically beneficial applied techniques which are appropriate to China's conditions

and are easy to implement widely; to set up pilot projects; and to gradually develop coal technology in a manner appropriate to China's needs.

With the cooperation of international researchers and the importing of advanced technology and experimental equipment from abroad, the specialized research units by 1990 will have completed the gradual transformation of scientific measurement and experimental techniques in China and the modernization of research and management procedures. At the same time, we must adopt various measures to improve the caliber of the research groups, strengthen the weak links in China's research, train specialists in all areas of coal research, and set up research organizations with increased scientific capabilities. As China progresses in this reform program, the specialized coal research organizations will become transformed from individual enterprise units into economic research entities concerned with management.

2. Key Objectives

The technology, management policy, and administration of China's coal mining industry will change radically by the end of this century. Specifically, labor will become more productive as machines replace manual labor; disastrous accidents and occupational illnesses will become more amenable to control, mining safety will improve, and the backward conditions in China's coal mines will be ameliorated. Instead of producing just raw coal, mines will output a variety of products, and there will be a tendency toward coal gasification and liquefaction and toward a reform of product structure; the interest of firms now engaged in single-line production will range more widely to embrace the development of coal electricity, coalification, and other areas of related interest; modern high-capacity trains for hauling coal, methods for water transport, and long-distance pipelines will replace the traditional methods for transporting coal. A key task of coal mining researchers in meeting the modernization needs of China's coal industry and bringing about the fundamental changes described above will be to master comprehensive modern prospecting techniques, which employ digital physical measurement methods and make exploration quicker and more accurate; to master special techniques for sinking shafts through thick alluvial strata, speed up the driving of horizontal drifts, and reduce the lead time for sinking vertical shafts; reform mining technology so as to increase yields and drivage rates, mechanize transport, improve recovery of coal resources, and ensure high, stable levels of production with high efficiency; develop preventive safety techniques, eliminate fatal accidents, monitor environmental quality more effectively, and ensure production safety; make rational, comprehensive use of coal resources, develop depth processing techniques, oversee and adapt the reform of product structure, and increase the economic benefits derived from coal.

3. Key Tasks

(a) Geological Prospecting of Coal Fields

These tasks include: carry out comparative research on coal strata, develop methods for quantitatively predicting the structure of deposits and calculating the size of reserves; study modern prospecting methods, particularly methods for interpreting and processing data from physical investigations;

find geological techniques for analyzing hydrological conditions and controlling the amount of water in rock; develop methods for prospecting small, short seams; solve the problem of trough-wave earthquakes; develop methods for horizontal drilling; determine the mechanisms of crack formation.

(b) Rapid Construction of Shafts and Tunnels

These tasks include: perfect the drilling and blasting method for sinking vertical shafts and develop a complete complement of equipment suitable for sinking shafts 1,000 meters deep; pursue ways for sinking vertical shafts through 500-meter thick alluvial strata by the freezing method; perfect drilling techniques to facilitate cutting through hard rock; perfect equipment for driving vertical shafts and horizontal tunnels by the drilling and blasting method; perfect the bolt and spray technique, make progress in dealing with rock resilience, coal dust, etc.

(c) Strengthen Mining Research

These tasks include: investigate rational ways of centralizing production; find technical methods for increasing unit productivity and drivage and for rapid elimination of water from coal beds; use microcomputerized controllers and light-weight capacitors to improve the lifting and transport capabilities of coal-hauling equipment in shafts; develop policies for the opening of new mines which address the problems of providing early financing, improving the extraction-to-drivage ratio, minimizing the amount of mine construction, reaching production quickly, and ensuring good economic benefits.

(d) Mechanization of Coal Mining

The problems here are to make mining machinery more reliable, advanced, economical, and better suited for mining applications; do research on high-efficiency coal plows and water-spraying plowing equipment; develop cheaper hydraulic supporting frames which are better suited for mining applications; extend the working lifetime of coal transport machinery and investigate the use of auxiliary coal-hauling equipment; perfect electrical equipment for guarding against explosions in mining areas; develop shaft-bottom electric controllers, ventilators, and signaling systems.

(e) Reform Mining Technology and Improve Hydro Coal Mining Techniques

The problems here are to develop mining techniques which do not require coal pillars, find methods for filling tunnels and ensuring safety, and make pillarless methods suitable in a wider range of mining situations; perfect the techniques for "U^3" mining and raise the recovery rate of coal resources; develop coal-mining methods and equipment for hydro coal mining, perfect the technological process, streamline production systems, and make these methods more generally applicable.

(f) Control of Gas and Dust in Mine Shafts

Develop low-ventilation techniques for eliminating gas from individual coal seams; perfect methods for identifying and predicting coal and gas burst

hazards; master methods for the automatic independent prevention of coal dust explosions; investigate methods for measuring gas concentrations in coal seams, assessing dust explosion hazards, and evaluating spontaneous combustion hazards.

(g) Coal Washing and Sorting Techniques

Develop modern, large-scale equipment for coal-washing plants; perfect techniques for removing water from coal slurry and methods for selecting raw coal by dry depth sifting; study desulfurization methods and techniques for separating coal from ash which reduce the use of flotation.

(h) Strip Mining Techniques

Study strip mining techniques and methods for improved management; study methods for controlling water flow beneath the mining site and investigate the stability of side slopes to collapse; resolve the problems with high stage boring, blasting techniques, etc.

(i) Gasification of Coal and the Use of Coals With Low Combustion Values

Study methods for gasification under pressure and the use of two-stage gasification furnaces suitable for mining locations; do research on coal recovery from waste rock and on methods for the rational use and disposal of waste rock; perfect the boiling combustion method, and make progress toward solving the problems of abrasion resistance and environmental pollution.

(j) Development and Application of New Techniques

The problems here include: redouble efforts in research into coal liquefaction, long-distance pipeline transport, coal extraction by thin high-pressure jets from nozzles; investigate supplementary caving methods, the applications of microcomputers in the coal mining industry, communication in mine shafts using optical fibers, etc.

In order to surmount these technical difficulties it will be necessary to organize model technical advisory facilities so that scientific methods can be implemented in production as quickly as possible. Communication among research, planning, and production departments must be encouraged so that new research results can be fully exploited in mine planning.

III. Predictions and Prospects

Coal research will develop rapidly between now and 1990, and the advanced technology required for the modernization of the coal industry will be made available.

Special techniques for drilling through thick topsoil (~ 500 meters deep) and alluvial strata will progress and develop, and lead times for shaft completion will generally be less than a year (this excludes preliminary work). Surface pregrouting techniques and the methods now in general use for sinking deep vertical shafts will be perfected, and engineers will strive to complete

shafts 700 ~ 800 meters deep within one year. Excavation machines with blades cutting over their entire cross-section will drive 3000 meters of tunnels annually; from 1,000 to 1,500 meters of tunnels will be dug each year by mechanized drilling and blasting equipment; the total drivage of machines digging for coal and semicoals will reach 3,000 - 4,000 meters annually. Progress in mechanizing and organizing the digging of tunnels will reduce the time required to sink shafts and will greatly speed up new mine construction.

The problems in constructing a full complement of mechanized coal mining equipment will be essentially solved. Comprehensive mining equipment able to mine seams 1.0-4.5 meters high will be completed, and their properties and lifetime will reach world advanced levels; the annual capacities of medium- and thin-coal seam comprehensive mining equipment will be one million and 400,000 - 500,000 tons, respectively. Microcomputers will be used to automatically control mining machines and monitor working conditions. High-grade, general mining equipment will be mass-produced, and highly efficient techniques for general-purpose mining of very thin coal seams will be available, along with high-grade mechanized mining equipment for recovering coal from collapsed roofs. Coal mining equipment currently has a tested lifetime of 600 hours; this will increase to over 1,000 hours, which compares favorably with the best equipment available outside China. New research results on the mechanization of coal mining equipment will be implemented widely and will play an important part in stimulating the mechanization of China's coal mining industry and in the reform of mining techniques. They will make an essential contribution to the rational strengthening of mining in East China.

Research on mine pressure and rock movement will stimulate progress in controlling solid roofs, shoring up soft-rock tunnels, and coping with pressure from the overburden in deep shafts. It will also stimulate the development of techniques for pillarless mining, for mining under water, buildings, and railroads, for mining of the outcroppings of coal seams in limestone karsts, and for safe bottom-up mining of groups of coal seams. Finally, this research will resolve some current technical problems of long standing and increase the recovery rate of coal resources.

We predict that reforms in hoist system design made possible by microcomputer and other advanced techniques will make it possible to increase the hoisting capacity by more than 15 percent in typical situations. Conveyor belt machines for long-distance transport of large amounts of coal will also be completely computer-controlled. We will solve the technical problems in building conveyer belt systems which run upward from the mine bottom at approximately 20°; auxiliary transport equipment with slider tracks or single-track suspension cables will be available, and techniques for transporting coal by pipeline will be mastered.

As for mine safety, effective low-ventilation techniques will become available for preliminary extraction of gas from coal seams, and breakthroughs will be made in techniques for removing gas by drilling surface holes. Water channel sheds, suspended water jackets, and other types of passive devices for reducing the danger of coal dust explosions will be tested and used, and automatic methods will be developed for preventing dust explosion. Ventilation at constant pressure will discourage fires, which will be put out by liquid nitrogen

or inert gases, foams, or flame retardants used in combination with ionic smoke detectors and automatic fire-extinguishing systems. At the same time, we will master techniques for monitoring and controlling the production environment at the shaft bottoms so as to make the mines more fire-resistant.

China will start manufacturing its own modern large-scale coal-washing equipment. The depth sifting method for separating coal will be mastered, and coal will become available in a greater variety of sizes; more than three million tons of raw coal will be saved annually through the elimination of mining cars powered by lumped coal. New techniques will reduce the ash content in high-grade coke to less than 9 percent. Techniques for removing sulfur (as pyrite) from coal will be further developed.

The gasification of coals under pressure will be fully analyzed; the two-step method for gasifying coal in gas furnaces will be perfected; critical research will be done on developing gasification catalysts, on controlling the liquid content of coal slurries and the combustion and transport of coal, and on boiling techniques for burning coals with low combustion values. In cooperation with other countries, China will strive to complete crucial experiments on the liquefaction of selected coals in order to provide a technological basis for making coal liquefaction an industrial reality by the end of this century.

In the future, computers will see wide use in all areas of production and management. We predict that computer-based management systems will be used in preliminary mine construction, to store, transmit, and process data, to optimize production management, and to aid in the decision-making process. Large data banks will be formed, and planning and policy-making will rely on scientific rather than empirical principles. Computers will be used for scientific calculations, to help researchers in the design of new products, as aids in construction planning and mechanization, to control the hoisting, transport, and washing of coal, and will radically transform industrial coal technology and greatly increase productivity.

We predict that as coal technology develops, we will see the construction of large, medium-sized, and small model mines, coal washing plants, two-step gasification furnaces, coal slurry treatment plants at mine locations, and systems for burning and transporting coal, all of which will be adapted to China's needs. At the same time, the knowledge and administration of coal science specialists will steadily increase, and Chinese research will become more competitive. Worker units cooperating in related areas of new technology will found research production associations which will gradually evolve into centers for the development of new industrial coal technology and into technical advisory centers, important test sites, and teaching centers for the propagation of new technology. The Coal Science Research Institute will continue to study, assimilate, and absorb advanced technology from abroad, and will import expertise, promote technical cooperation with other countries, and strive to make new and even greater contributions toward the fulfillment of China's strategic objectives for the coal industry.

12617
CSO: 4013/60

COAL

REFORMS OPEN WAY FOR 'UNPRECEDENTED' MINE CONSTRUCTION

Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese No 10, Oct 84 pp 13-14

[Article by members of the Coal Industry Capital Construction Company]

[Text] Since the founding of the PRC, basic construction in China's coal industry has been vigorously pursued and great progress has been made toward providing a solid foundation for future development. In the last 35 years, 1,854 new mines have been opened with a new increased production capacity of 469,560,000 tons, and a new mine is put into production every 7 days on the average. The rate of China's mine construction is among the highest in the world.

China already has 11 mines with a capacity exceeding 10 million tons (Datong, Kailuan, Jixi, Hegang, Fuxin, Fengfeng, Yangquan, Xishan, Pingding Shan, Huaibei, Xuzhou), and there are 19 mines with production capacities between 5 and 10 million tons. The overwhelming majority of these mining areas were constructed after 1949. Coal dressing plants, which in 1983 were capable of processing 133,720,000 tons of washed raw coal, have opened up wide new areas in the development of China's steel industry and the comprehensive utilization of coal. Large-scale construction is currently in progress at the 12 principal mining sites in Huainan, Huaibei, Yanzhou, Zaoteng, Kailuan, Yangquan, Datong, Gujiao, Pingding Shan, Datun, Tiefa, Shuangyashan, and at several strip mines (Huolinhe, Yiminhe, Pingshuo, etc.). The objective is to contribute to China's goal of increasing annual coal production to 1.2 billion tons by the end of this century.

Chinese mine construction technology has developed greatly in the last 35 years, and planning and construction facilities have become available. During the First Five-Year Plan, China mastered techniques for planning and constructing mines capable of producing 300-900 tons annually. During the second and third five-year plans, China was able to independently plan and construct mines with a yearly capacity of 1.2-1.8 million tons. During the last decade China has independently planned and constructed large mines with an annual production of 3-4 million tons using domestically manufactured equipment. The recent importing of Western technology and the international cooperation in technological development have begun to yield significant technical and economic results. The mine at Xinglong village in Yanzhou was built in 6 years and 10 months and has a planned annual capacity of 3 million tons of coal; production broke

through the 1 million-ton barrier the first year after production was begun. With a planned capacity of 3 million tons, the Guajiao mine at Xiqu was put into production this year after 5 years and 4 months of construction. The Datun coal washing plant was built in 40 months and can wash 1.8 million tons of coal annually. The advanced methods used to design this plant have reduced the water concentration in the coal slurry and made it possible to use dehydration methods, recycle the water, and keep the coal sludge confined to the plant. This has reduced pollution, conserved raw materials, and resulted in "civilized" production.

Obvious progress has been made in tunnel construction techniques. The first step in using drilling machines to replace manual labor was taken shortly after the PRC was founded. Jackhammers were used in the 1960's. Today, ring- and umbrella-shaped drilling platforms and rock-drilling platform cars are used to drive vertical shafts and horizontal tunnels, respectively. Effective techniques for blasting long (3-4 meters) and moderately deep ($\geq$ 2.5 meters) holes are widely used, and long-hole smooth blasting has also reached a rather high technical level.

More than 85 percent of loading machines are now mechanized. The older manually operated rock grabbers (of capacity of 0.11 m^3) have been replaced in large shaft-sinking projects by mechanically controlled rock grabbers with a capacity of 0.4-0.6m^3. Loading machines with rakes, shovels, or side-loading equipment are generally used in the construction of horizontal and inclined tunnels. Anchor supports with sprinklers are employed in from 60 to 70 percent of newly constructed mines, and mechanization has been pushed and manual labor and costs reduced. Advanced techniques such as mortar chutes for supplying concrete, pumps for transporting concrete, and slide forms are used to build shaft linings. Wooden mine supports are starting to be replaced by steel supports.

The construction of vertical shafts and horizontal and inclined tunnels has been speeded up by combining various technical advances and appropriate technical reforms with the systematic mechanization of various types of comprehensive production lines. Complete sets of production equipment are in use in 20 vertical shafts. The 630-meter-deep Xinghua shaft, the main shaft at the Jixi mine, was constructed in 1983 at an average rate of 54.8 meters per month. The record of 174.82 meters per month was reached by the Hunan Coal Capital Construction Company at its No. 5 construction site at Qiaotou He. This record was recently broken by the Shanxi Yangquan Mining Bureau, where a water-equipped downcast shaft was constructed at a monthly rate of 177.02 meters, which is the current record for all of China. The record of 705.3 meters for a slope was set by the Tongchuan Capital Construction Company at its No. 2 worksite in the Xiashijie mining region, where a downcast inclined shaft was constructed. Comprehensive mechanized equipment sets are now being tested for driving tunnels through rock, and good results of 507.7, 585.8, and 260 meters have been achieved in roadways at Sichuan, Kailuan, and Hunan, respectively, through the use of production equipment with loading cars (shuttle loaders or switching and loading machines equipped with rakes). China has successfully drilled kilometer-long vertical shafts at Beipiao Taiji, Guanshan, and shaft No. 7 at Niutou Shan in Zhejiang Province. Shaft-boring and tunnel-driving equipment is now finding use in some of the coal mines. Drilling machines have sunk 33 shafts with a total length of 6,400 meters. The maximum diameter

of the 508-meter-deep air shaft at Pansanxi is 9 meters. At the Wangping tunnel construction project in Shanxi Province, the rock-boring equipment is advancing along a 3-meter-diameter tunnel at a rate of 301 meters per month.

China's special shaft sinking methods have reached world advanced levels. Two hundred and three shafts have been constructed by the freezing method at a maximum monthly rate of 183.3 meters; the total drivage distance is 30,000 meters, and the maximum shaft depth is 415 meters. China's experience in assimilating Western technology and in the theory and practice of walling have resulted in new breakthroughs. The drop-shaft and curtain wall methods are used to drill vertical shafts through water-bearing strata. The depths are continually increasing and have reached 192.7 meters, and these techniques continue to be developed to some extent. Techniques for spraying broken loose rock layers are also being rather actively developed.

Developments in the construction of surface structures are also suitable for the special needs of coal mining construction. Both permanent and prefabricated mobile drilling derricks are employed. Slide forms are widely used for constructing the derricks; concrete transporting pumps have been developed, and techniques have been found for constructing and working on tall scaffolds. In addition, methods for adding impurities to concrete and for protecting roofs from water are now widely used.

Modern mining management methods are finding increased application. Computers are used for planning, and are becoming more common in networking science and management applications, in finance, prognostication, in allocating available manpower, and in other areas. Unified integrated planning has become the rule during the organizational stage and has shortened lead times and reduced the manpower and physical and financial resources needed to complete projects. Starting in 1982, comprehensive quality control was introduced in mine construction. At present there are 18 capital construction bureaus (companies) in the coal industry which are involved in the teaching of comprehensive quality control (QC); QC work groups have been set up which use maps and charts to monitor the quality of the engineering project (shafts and tunnels, structures, and installed equipment). As a result of its careful planning and engineering, the coal washing plant at Datun was judged China's outstanding facility and awarded the 1983 gold medal of the National Workers Association for all-round engineering excellence.

Efforts are constantly being made to develop the personnel involved in the capital construction of mines. During the First Five-Year Plan, a large group of outstanding cadres and workers was transferred from mine production in order to found 12 local capital construction bureaus. These bureaus have contributed greatly to the construction of the old mining regions in northern and eastern China, and to the development of coal fields in northwest and southwest China and south of the lower reaches of the Chang Jiang. As the scale of construction has increased, each mining region has set up appropriate groups of construction engineers, so that today there are 29 planning institutes and 50-odd planning offices in the Mining Enterprises Department which employ over 12,000 people. There are 204 construction engineering offices with 430,000 workers. In addition, China has metallurgical specialists and municipal and county building engineers who are involved in mine construction. In 1983, 110

tunnel-boring teams dug more than 1,000 meters of new tunnels and achieved national recognition; the average person yearly workface area completed by the 90 building installing teams exceeded 40 m^2, the labor productivity exceeded 6,500 yuan, and the teams received national recognition for merit. These nationally recognized workers account for more than 40 percent of all the projects completed in China and comprise the backbone of the construction force.

The progress in coal mining capital construction since the Third National Congress has been unprecedented. After regulation and consolidation by the Party, the coal industry underwent thorough reforms. These reforms focused on improving the speed and quality of construction and on increasing the scale of production while reducing costs and lead times (the "three ups and two downs"); in the economic organizational reforms, the two principal areas stressed were financial accountability and the handling of contracts and bidding on projects. Advanced mine-planning techniques were borrowed from abroad, comprehensive mining technology was actively developed, the mechanization and automation of shaft-bottom equipment was actively pursued; the proportion of coal tunnels was reformed; new mines were opened at an accelerated pace, and attempts were made to sink large, highly productive shafts which were profitable, required little manpower, and could be constructed quickly. The capacity of the No. 3 mine at Jining now planned by the Shandong Coal Mine Planning Institute is to be 5 million tons, which works out to 5 tons per worker; the lead time is 5 years, and more than 50,000 meters of shafts and tunnels will be excavated. In summary, the reforms in planning have resulted in extensive blueprints for modernized mines which are opening up vast new prospects. Progress will be accelerated still further by reforms in mining construction and in the mining workforce, and by taking out foreign loans and importing technology from abroad. With hard work it will be possible to resolve the problems of high cost and long lead times which have hampered mining construction.

As we review the past and look toward the future, we expect coal mine construction to progress rapidly as reforms continue.

12617
CSO: 4013/60

COAL

USE OF COMPREHENSIVE MINING MACHINERY GROWS DRAMATICALLY

Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese No 10, Oct 84 pp 19-20

[Article by Wang Huanwen [3769 3562 2429], Deputy Director, of the Production Company of the Ministry of Coal Industry]

[Text] 1. Introduction

China's coal industry has advanced rapidly since the founding of the PRC, and raw coal production has increased by a factor of 22--from 32.4 million tons shortly after the Revolution to 715 million tons in 1983. China is currently the third largest coal producer in the world. The increase in coal production and the mechanization of coal-mining equipment have had major effects: Coal extraction has become more productive and mine performance as judged by technological and economic criteria has also improved as mining technology and equipment have been perfected.

Since the founding of the PRC in 1949, China's coal mining techniques and extraction technology have undergone extensive reforms. In the 1950's, the longwall method using powered extensible roof supports stimulated the widespread mechanization of mining equipment. Of the five major steps in the longwall method (coal digging, loading, transport, roof support, extraction), transport was the first to be mechanized. After 1949, blasting replaced the pickaxes formerly used to dig coal out of the seams, and in the 1950's loading machines and combines were used to mine coal. In 1963, easy-loading rollers began to appear in coal mines, and the scope of mining machine applications was expanded. In the area of supporting equipment, metal friction support columns and hinged roof-support beams came into use in the 1960's. Self-contained hydraulic supports and frames began to be used in the 1970's, and the process of using and recovering support columns was mechanized. During the early 1970's, China began developing and implementing comprehensive mechanized coal-mining equipment, and comprehensive mining has developed extensively throughout China in the 1980's and is now well-established.

The National Consolidated Mining Business Department currently has 71 bureaus with mechanized mining equipment, and 31 of the bureaus (operating a total of 90 mines) use comprehensive mining techniques. In recent years many mechanized worksites have reached high levels of production. For example, annual production often reached 450,000 tons at mechanized workfaces where friction support

columns are used; up to 550,000 tons is produced annually where stand-alone hydraulic supports are employed; production reached 910,000 tons per year at hydro coal mining workfaces; 15 comprehensive mining teams have made production breakthroughs of 1 million tons per year, and the record is 1.18 million tons. The per-unit production of 144 comprehensive mining worksites averaged 35,664 tons in 1983; the average for 43 high-grade general mining workfaces averaged 16,519 tons; the corresponding figures were 11,707 and 17,360 tons, respectively, for 355 general mining workfaces and 23 hydro coal mining sites.

Mechanized coal mining has become an important tool in the development of China's coal production. In 1983, one-quarter of all coal mining sites in China were mechanized, and these sites accounted for two-fifths of total coal extraction. Comprehensive mining technology has developed rapidly during the last 5 years, accounting for 12.37 million tons of coal in 1978 and increasing to 60 million tons in 1983. Comprehensive mining has brought with it extensive changes in the way coal is produced.

The development of comprehensive mining is primarily responsible for stimulating the mechanization of mining equipment and has brought about encouraging changes in mining techniques and prospects. During these years 388 mines were remodeled for a net increase in productivity of 53.47 million tons per year. Comprehensive mining has also made it possible to centralize production at coal mines. The efforts in reforming mining technology focus on simplifying the centralized production systems and raising per-unit production and mechanization levels. Comprehensive mining technology is highly productive, safe, and efficient, and its consumption demands are low. Moreover, it has provided solutions for many difficult technical problems; for example, the mining of coal seams 2.5-3.5 meters thick used to be difficult but is now routine and highly productive owing to the use of comprehensive methods. Comprehensive (combined) techniques are well-suited for handling solid roofs, and injuries and deaths have been reduced and recovery rates raised. The production and technical management associated with comprehensive mining are in the process of being systematized, modernized, and put on a scientific foundation. This will serve as an important stimulus to progress in coal mining technology, research, planning, and construction. For this reason most of the stress is on the development of comprehensive mechanized mining equipment, and this is the direction in which the industry is headed.

II

Looking back on the last 30-odd years of coal mining mechanization, we may note several successful experiences which have shaped China's coal mining scene. We list several of these:

1. The rational remodeling and transforming of mines and the implementation of centralized production have created conditions favorable for mechanization. Centralized production represents an advance in the quality of management and technology of the coal industry. Experience has shown that comprehensive mining technology is particularly valuable in large mines. Statistics indicate that 90 percent of the comprehensive mining sites with average monthly production above 40,000 tons in fact have annual outputs exceeding 1.2 million tons. All of the comprehensive mining teams breaking the 1-million-ton-per-year

production barrier in 1981 - 1983 were located in large mines with annual production exceeding 2 millions tons. For this reason, methods for making mines bigger, improved deployment of tunnel-driving equipment, and optimized centralized production will be needed in order to promote mechanization.

2. Stress has been placed on increasing both extraction and drivage, on doing careful preparatory work prior to production, and on decreasing the time needed to move comprehensive mining equipment from one location to another. It is desirable to increase the number of comprehensive mining workfaces and to move the equipment more frequently. Careful plans have been developed on the basis of a decade of experience; scientific organizations have gained experience in moving from one worksite to another and transit time has been decreased and efficiency improved.

3. Comprehensive, high-grade, and general mining together form a framework in which mining mechanization has been vigorously promoted for gently sloping and stable coal seams; mining is carried out beneath metal nets, below crushed roofs, and underneath solid roofs. Mining in areas of complex geological structure will become a reality ahead of schedule, provided that geological technology and management are strengthened; the range of inclination angles for which seams can be mined has been increased; comprehensive mining is employed in gassy mines; irregular deposits are being mined and rotor drills have been developed.

4. Provide the infrastructure required for the mechanization of coal mining technology, and set up equipment leasing and testing and repair centers. The need for such centers has become increasingly evident as mechanization has progressed. In general, each mining business bureau may plan its own repair center, but such a center may be shared by several bureaus. The testing and repair centers should have a complete set of measurement and testing facilities and should ensure that the equipment is in good repair. At the same time, centers for supplying spare parts should be established so that mechanized equipment can be returned to efficient production in good condition.

5. Carry out initial research on comprehensive planning, and manufacturing systems suited for China's needs.

6. Formulate management policies for mechanized coal mining and train a well qualified management corps. Since the introduction of comprehensive combined mining techniques in 1974, increased attention has been given to the establishment and training of workers. The productivity of comprehensive mining techniques has improved steadily as a result of these rigorous training procedures. During the last decade, 26,250 workers in 232 groups have been organized and trained. Last year, the Ministry of Coal Industry set up technical centers for research and training in the mechanization of comprehensive excavating equipment and technical advisory centers concerned with coal mining; 40 master engineers in mining machinery and electrical engineering are trained locally in two classes each year.

7. Scientific guidelines for regulating normal production are essential if high and stable production levels are to be achieved. Much progress toward achieving scientific management and establishing normal production rules can

be made if we set up standard work cycles and ensure that construction and maintenance are of high quality. The "four-six" work method, in which three teams mine coal at comprehensive mining worksites and one team tests and repairs the equipment, should be used in order to ensure proper maintenance. Smooth production has been ensured at some mines by instituting regular work cycles and by testing and repairing equipment in accordance with factory specifications.

III

In order to meet its objectives of inaugurating a new era in coal mining and doubling and quadrupling production so as to reach 1.2 billion tons of raw coal by the end of this century, the Ministry of Coal Industry plans to accelerate mechanization so that the industry will be 50 percent, 70 percent, and 85 percent mechanized by the years 1985, 1990, and 2000, respectively.

The plans continue to stress the mechanization of comprehensive mining equipment and the development of high-grade general mining techniques; comprehensive mining is to be the principal means for increasing future coal production; reforms in general mining practices should be speeded up; where mine conditions are favorable, hydro coal mining should be developed, while blasting methods should be phased out.

The most important event in coal mining mechanization over the past 30 years has been the development of comprehensive mining equipment during the last decade. China must continue to develop comprehensive mining equipment at a satisfactory rate in the future and must continually expand its range of applications. We predict that with the coordinated development of training, research, manufacturing, capital construction, and production in China, the three basic prerequisites (research, training, and manufacturing) will gradually become available for making rapid advances in comprehensive mining technology.

Progress here will depend on advances in science and technology, and on the continual use of new procedures and techniques, materials, and equipment. We must develop and plan methods for mass-producing lines of comprehensive mining equipment which are standardized and suitable for general use. We need to actively pursue breakthroughs which will make it possible to mechanize equipment for mining steeply inclined or very thick coal seams, and we must continue to establish and develop closely knit organizations concerned with research, planning, manufacturing, supply, and production.

If we develop China's productive capabilities extensively and earnestly, if workers follow the guidelines outlined above, and if the quality of management and the level of mechanization are continually improved, the development of coal production will be promoted.

12617
CSO: 4013/60

COAL

SYMPOSIUM ON EXPLORATION IN PRODUCTIVE MINES HELD

Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese No 11, Nov 84 pp 8-12

[Text] Editor's note: Nation-wide, 70 mine bureaus have established production exploration teams, using over 500 drilling rigs of every type, adapting themselves to the latest technology, clearly improving every technical and economic index. The statistics for 1983 show an average drill/month ratio of 272.6 meters, with the greatest single month figure for one drill 888.9 meters and the best annual total for one drill 6,083.3 meters. Quality checks revealed a class A and B hole ratio of 85 percent, with an average investment of about 80 yuan per meter. The production exploration teams continue to make themselves something that coal mine production and technology upgrading cannot do without.

The mission of production exploration is a truly difficult one, if it is to meet the demands of "doubling to guarantee quadrupling." Production exploration work is required for making a thorough investigation of various geologic problems encountered along the way; to increase the reserves and improve the grades found within mine zones and mine pits; for accumulating information on hydrogeology and interior geology for the deep underground engineering planning needs for deeper mines; and for every sort of engineering, hydrology, research drilling projects, etc. To achieve these goals there needs to be an additional 500,000 meters of test holes drilled annually nation-wide.

To meet this end, the Production Office of the Ministry of Coal Industry convened a symposium on "Production Exploration for China's Coal Mines" on 4 April at the Zifu Mine Bureau. Prior steps in engineering experience were summarized, the plan for key future work was firmed up. It was also demanded that the agenda for production geology production work be raised to a more important level, to effect a doubling of the coal production base. Gleanings from the work experiences included in of some of the production exploration units' reports to the symposium are reproduced below.

Do Your Production Exploration Work Well; Be a Pioneer in Coal Production [1]

From 1981 to 1983, our unit submitted 2 precision supplementary [production] geological reports and 3 exploration plans; altogether discovered reserves

of 103 million tons, newly added reserves of 33.6 million tons, and upgraded the quality of 18.3 million tons. We provided geological data for the deepening of mines and digging of new mines in the mine area. We were cited as a leading unit in the Shandong coal system in 1983. In the 13 years since the Ministry of Coal Industry began the single rig competitions, 14 of our rigs have been in the winner's circle.

1. Stress team-building. After trying every type of education and professional technical training, we began in 1982 to put on 6 short courses in technical training, taking the technical personnel to the worksite to combine lectures on practical application with young worker's studies of drilling. Consequently in 1983, at the time of the technical improvement tests and practical tests, 96 percent tested in the top grade for technical standards, and this is well suited to the demands for production.

2. Stress rules and regulations, establish a system of economic responsibility. We established and perfected 215 regulations and we created a work responsibility system for 61 position descriptions. We instituted rigorous inspections to see that every rule was fully carried out. This caused our enterprise economic efficiency to increase every year. Expenditure was lowered 4 to 5 percent below that planned for 1981 and 1982. In 1983 73 days were saved from mission plans, we supported the 5,500 meter precision supplementary production exploration for the Dezhou area, we covered 18.9 percent more drilling footage than planned, and expenditure was 14.9 percent less than planned.

3. Stress on-the-scene administration. A) Rely on technical personnel to solve key technical problems. B) Tighten up administration of initial record-keeping: area covered per drilling rig; mafang rock (coal) cores, accident measures; and every type of initial technical record keeping. It must be accurate, complete, and clear. C) Keep rigid quality control, give detailed advanced notice of coal sightings. In 153 holes since 1981 our unit has produced a 78.8 percent ratio of drill holes to coal cores found. After quality checks, the class A and B hole ratio is found to be 98.7 percent.

4. Stress single-rig competition. Setting the class A and B hole ratio to 98 percent, the monthly drilling to be 450 meters, monthly expenditure to be reduced by 5 percent, no serious accidents or no injury-accidents: these are the targets for high grades. In 1983 ten drilling rigs exceeded their total mission, with average monthly drilling of 469 meters, 11.7 percent above plan, with the in-hole accident rate lowered by 6.6 percent.

5. Stress employee benefits.

Improve the 1,000-meter Drill Rigs, Increase Deep Exploration, Serve Mine Technology [2]

In recent years all mines under our mine bureau have found that due to intensified development the shallow reserves are quickly exhausted, but for depths below -600 meters there is only physical prospecting data and

a lack of test drilling. In order to enable the mines to continue to produce at a steady rate and to raise production the need for deep exploration, and the need for reliable geological data for -600 meters and below are matters of ever increasing importance. Our bureau's exploration plans for 1975-1985 called for over 200 drillings of more than 1,000 meters. Faced by the fact drill rigs could only reach to about 800 meters, we organized our efforts to satisfy the urgent need for improvements in mine pit technology. On two occasions in 1977 and 1980 we succeeded in making the cold water flow bigger and increase the capacity to brake downward motion, and other technical undertakings; these were improvements on the 1,000 meter drill. In 1980, experimental work began on hole 31-15. At the shallow depths we stressed the prevention of diagonal drilling. After the depth exceeded 800 meters we performed strict maintenance on the equipment; inspected the drill, and the relationship of the mud quality to coal cores. On 21 July we finished work. The work had reached to 1,442.63 meters, running for 143 days, with a monthly drilling index of 1,307 meters. The engineering quality was ranked class B. Two coal strata 3.7 meters thick were found at 1,307 meters, roof and floor rock samples were removed intact. The coal core index was 94 percent; the sample removed weighed 94 percent. This was a rather good geological result.

By the end of 1983 our unit had drilled 36 holes using the improved 1,000 meter drill rig. There were a total of 42,745 meters drilled in holes deeper than 1,200 meters; the average monthly index was 439 meters. The internal geology data obtained provided a reliable basis for the improvement of mine pit technology. The reserves at Yi'an and Zhangxiaolou were increased 300 percent, mine pit technology was improved and production capacity was increased by 100 percent and 150 percent respectively.

Rely on Science and Technology; Raise the Quality of Exploration [3]

In recent years we proceeded from a foundation of emphasizing foundation work, with attention to importing modern technology and techniques, to raise the quality of exploration. The specific methods were:

1. Use the best quality chemical mud. Since 1978 we have purchased the new generation of mud testing instruments, set up a mud laboratory, compounded Fuxin district's chemical mud and put it into use, increased administration of its use, and caused the in-hole accident rate to drop steadily every year, from 38.9 percent in 1978 to 20.7 percent in 1979 to 8.9 percent in 1980 to 2.6 percent in 1981 to 2.3 percent in 1982 to 1.9 percent in 1983. Drill rig 803 was working on hole 83-12 when at a depth of 680 meters a great quantity of dropped pieces was suddenly encountered. An on the spot chemical analysis showed that the mud had a high water-loss rate so the mud was promptly changed and this prevented a drill-blocking accident from occurring. Events have shown that the use of top quality chemical mud is one item of technical endeavor that is of across the board importance in completing drilling missions.

2. Use the new hot spray coating method. In 1982 we imported this technology to use on core sampling pipe connections which are easily worn out,

on water pump pull rods, and on coring instrument block springs, etc. Applied to the surface of these parts, they then have a thin but strong anti-wear layer. Experiments have shown that the useful life for block springs and phi 91 mm rock core pipe joints has been raised about 700 percent and 200-300 percent, respectively.

3. Improve borehold exploration techniques. Using the K3 coal coring pipe and a rock core cutter to extract coal and rock cores, and a slant type core instrument of our own device to improve the quality of work in collapsed coal strate, and the use of weighted pipe-guide pilots to prevent the drills from deviating from the limits of the diagonal, all these techniques, have brought visible improvement to every target. In 1983 the average coal core sampling rate reached 86.3 percent, the class A and B hole ratio was 100 percent.

4. Increase parameter surveys. On the basis of the parameters of necessary surveys that had been completed, we increased surveys on the diameter curves and "warm" curves of the mines. In 1983 we completed 22,342 meters of drilling, and published 2 production supplementing precise exploration reports, and raised the reserves by about 10 million tons, and raised the grade of 3.6 million tons. We wish to import more technology, the experimental new rope core sampling techniques, and new equipment. We will rely on science and technology to raise the standard of our borehold exploration.

Set Positive Goals for Exploration, Serve Coal Production Even Better [4]

The stratification of the various mines in the Baisha mine district is fairly developed, there are lotus root formation, string of pearls formations, henhouse formations; the geological conditions are very complicated. In 26 pairs of mine pits, only 2 pairs show the goelogical characteristics predicted by precision surveys. Several mines quickly exhausted their reserves due to insufficient exploration. There are 6 pairs of mine pits already advancing to a premature old age. Three pairs of mine pits were forced into production exploration pit status. Replacement faces on the same level were in short supply in all the mines in the bureau. These pressing demands forced an improvement in the quality of geological exploration work and an increase in coal prospecting work outside the mine area proper. Cooperating with production, mine pit deepening and face replacement allowed us to complete 136 bore holes, for a total of 54,688 meters. Since 1980 we have produced and approved 4 supplementary geological exploration reports, proven 20 million tons of reserves, shown a net increase of 4 million tons, and upgraded 5.5 million tons.

1. We confirmed a principle coal stratum intersecting but not cut off by the Pingdong-Yanzitang fault; thus we enlarged the Pingdong coal face area, adding to the reserves by 740,000 tons, and increasing its workable life by 10 years.

2. In addition to proving a 380,000-ton first level industrial quality reserve at Longjiashan, we also contributed minable reserves of 7 million tons in the mine boundaries.

3. We clarified the contrasts shown in the Zhilanchong mine's rock strata; we determined that the principle coal bed consisted of only one strata of number 5 coal, and number 6 coal deposits were sparse or absent. At the same time we disproved the proposition put forward by the initial geological report which said that there were two perpendicular faults with a dip greater than 50 meters; this provided reliable geological information for the planning for deepening the mine.

4. We found 3 coal beds below the bottom of the Tongzishan mine, and we found a principle coal bed within the Bawangmiao anticline. We predict the reserves in these beds will total 5 million tons. We are also in the preliminary stages of proving a 5- to 10-meter thick bed of number 7 coal outside the boundaries of the mine, and we estimate this will add 4 million tons to the reserve.

Logging: an important technique in raising the quality of exploration [5] Since the organization of our logging unit in 1975 we have done 109 test holes. Using logging makes geological data more reliable. For instance, at hole 438 in the Honghui mine area the rock was rather fractured, due to faulting, the rate of success in getting roof and floor rock samples was poor, coal cores were only obtained at a rate of 35 percent. It was impossible to tell the thickness of the coal by the bore hole method. It was suggested by a logging, and proven by pit wall cores, that the coal bed was 7.1 meters thick. Also the Honghui Quaternary system wave-lapped sediments and flood sediments are very loose, and the rate of success in obtaining rock cores is very low; with drilling alone it is very hard to determine the water retention qualities there. Using logging to harmonize the geological data, the thickness, depth and water-filling conditions of the water bearing Quaternary strata were sufficiently understood. A comparison of logging information from 15 test holes in the Honghui area with data revealed after mining actually began showed an error range of only about 5 percent, which demonstrates that logging data is rather reliable.

To further increase the precision of the interpretation of logging data, we frequently go to producing mines to investigate, compare, and make timely calibration of our instruments. When logging we regularly compare the logging curve with the curves from neighboring holes' geological data and core sampling data, to further ensure the reliability of the logging quality and the precision of interpretation. Again, in 1983 while working on hole 83 at Dashuitou, the logging curve beneath the first coal stratum reflected two areas with anomalies resembling thin coal strata. But drilling samples taken from these two areas showed no coal. Multiple pit well sampling demonstrated that the coal-like anomaly was a collapsed second coal stratum, making up for the inadequacies of the bore hole method.

Increase Administration of Techniques, Prevent "Crooked" Holes [6]

The Lianshao coal field is a series of small coal bearing synclines in a "Y" formation striking Northeast. The dip angle is steep, it is faulted throughout, the rock strata are fractured. The lithology of the coal series strata is hard and soft next to each other, corrosion and fissuring of the

limestone is well developed, flint is often found there. Thus there are often accidents caused by crooked holes when they exceed the limits of deviation. The drilling rate per month is consequently fairly low. After repeating this experience over and over we began to model a set of methods to prevent crooked holes. Those holes begun in 1983 all had deviations within quality standards A and B. The monthly drilling rate was up 22 percent over 1982 and the accident rate was down 5 percent, bringing about good technical and economic efficiency and geological success. The principle lesson was: carefully guard every quality related link that resides in a crooked hole. Synthesize the concrete conditions of the work are and stress small-diameter holes, diamond drills to conquer hard rocks, and improved drilling tools in working. Use phi 68 mm drill runners 30 to 60 meters long on the ends of rock core tubes, and between the runners use connectors the same diameter as the drill head, and your operation should achieve results in preventing crooked holes. Because crooked hole factors are very complicated, we are continuing to investigate them.

Experience in Using 1.5-meter Diameter Drills [7]

In order to resume production on the second level at the Yanmazhuang mine it was necessary for us to drill two 1.5 meter diameter water pumping holes from the surface works to connect directly with the second level sump, and install two submerged pumps. The question was, were we able to successfully complete such holes? Our unit utilized modified oil drilling equipment of Chinese construction, used high quality "Shuangqu" chemical mud, circulated by the drill advancement method, and in addition as the drilling progressed, we stressed the measurement of deviation and the prevention of a "crooked" hole. Simultaneously we established safe working measures, and in September 1983 we completed pump hole number 1 at a depth of 321.8 meters, and right on time. Working on this basis, we started pump hole number 2 in November of 1983 and completed it in March of 1984, at a depth of 292 meters; the average daily drilling rate was improved 85 percent over pump hole 1, an obvious increase in efficiency. There are still some problems involving this kind of drilling that need to be worked out. In mine areas near large bodies of water, this will better serve the mission of using submerged pumps in mine pits with high water levels.

Use of Three-way Rotary Bits in Deep Well Drilling [8]

In order to meet the water prevention engineering needs of our bureau's mine area, we place greater emphasis on internal hydrogeological bore hole testing every day. Because this type of hole has a big diameter (as great as phi 311 mm), a great depth (as much as 1,000 meters) and the rock covering the target beds requires large diameter drilling over a great distance (400 to 850 meters), so the difficulties are great. If we had to rely on repeated small diameter drilling to do the job, the equipment would be very complicated, and we would have to use expansion instruments and expansion drills 4 to 6 times to make one hole, requiring repeated drilling operations and a causing the footage to be low. Expenditure of steel and hardened alloys would go up, the bore hole wall would often be stripped away and collapse easily. The use of large diameter tubular bits

to make the hole in one drilling operation makes the load on the drill rig too great, making the drilling equipment subject to breakage, core sampling difficult and the efficiency rare low. For all these reasons we studied the experience of exploratory oil well drilling, and chose the three-way rotary bit to use in our large diameter projects. The method consists of selecting one of 6 three-way bits in the range of phi 152 to 311 mm, matching it with a weighted pilot tube of the same diameter, and expanding the diameter of the drill runner out to that of the drill bit by using a wall of seamless steel tube, reinforced with welded hardened alloy rods and plates. This makes for a drilling tower with a stable center of gravity.

Now that our unit has selected this method of working we have had success using a three-way bit for a single pass to drill large diameter holes. In strata where we must cut cores we first use a small inside diameter bit to cut the core, then we use a single pass of the three-way bit; we have had success in this too. When working in multi-strata worked-out areas of about 300 meters we use a small inside diameter bit to cut a pilot hole, then use the three-way bit to finish in one pass. We have accumulated certain experience in this too. Practice has shown that the techniques involved are simple, the quality of engineering is high, and it is very applicable to bore hole exploration for internal hydrogeology.

Large Diameter Bore Hole Working and Applications [9]

The Feicheng mine area has 6 mines in the planning stages that will require large diameter holes for pumping water, carrying electric cables, and moving coal. This type of hole has great utility in improving coal mine production and technology because it involves a short path of travel, needs no maintenance, has a high rate of efficiency for water pumping and uses little electricity. There are two key points in working with large diameter holes:
1) The deviation of the bore slant must be strictly controlled; and
2) After the pipes are put in the sealing quality must be maintained. Our unit, by establishing strict operating rules, has been able to make 17 large diameter holes, each satisfying all quality demands. In 1984, as the Yangzhuang hole got to about 170 meters the deviation was only 30'. In using the buoyant valve method of lowering water pipes, we forced concrete into the ring shaped space between the pipe and the bore wall and kept the concrete from being forced back into the pipe under pressure. This guaranteed the sealing quality, and quality inspections of all holes have shown excellent results.

The use of large diameter holes allows us to avoid running numerous pipes and wires through the pit shaft, with resultant effect on ventilation and transport of materials; and it can be used to further rationalize the improvement of mine technology. After a large diameter water pumping hole was built at -90 meters in the Taoyang mine, it caused the effective area of the pit shaft to be reduced and, because it bore hole came in the vicinity of the pump room, it saved about 980 meters of tunnelling. We estimate that after the savings in pipe will be 4,000 meters at Taoyang and Nangaoyu alone; a savings of over 300,000 yuan. One thousand meters of tunnelling will be eliminated, for a savings of over 400,000 yuan, and a reduction in water pumping costs of 110,000 yuan.

[1] Zifu Mine Bureau, Geological Exploration Team
[2] Xuzhou Mine Bureau, Geological Exploration Team
[3] Fuxin Mine Bureau, Geological Survey Office
[4] Baisha Mine Bureau, Geological Exploration Team
[5] Jingyuan Mine Bureau, Geological Exploration Team
[6] Lianxiao Mine Bureau, Geological Exploration Team
[7] Jiaozuo Mine Bureau, Hydrogeology Team
[8] Huainan Mine Bureau, Bore Hole Exploration Team
[9] Feicheng Mine Bureau, Bore Hole Exploration Team

12663
CSO: 4013/77

COAL

RAIL, WATERWAY PROJECTS TO BRING MORE COAL TO COAST

HK040434 Beijing CHINA DAILY in English 4 May 85 p 3

[By CHINA DAILY staff reporter]

[Text] Wuhan -- The chief of China's coal industry has called for using waterways to help solve the problem of transporting coal in the country.

Minister Gao Yangwen told reporters in Wuhan that it was a major mistake not to have fully used the Huang He as a principal shipping channel. "It was an economic blunder, particularly for the coal industry," he said.

In the past, China depended mainly on railroads to transport coal from inland to coastal areas. Coal shipments account for 40 percent of the country's and 90 percent of Shanxi Province's rail transport capacity, yet most of the coastal cities are still short of coal while millions of tons of coal are being stockpiled near the coal fields in Shanxi waiting to be shipped out.

China produces more than 700 million tons of coal per year, and Shanxi Province takes up nearly 50 percent of the total. The state has invested heavily in building more railroads to link Shanxi's coal-producing centers with coastal cities. A major project is under way to build an electric railway between Datong in northern Shanxi and Qinhuangdao Harbor in northern Hebei Province.

But in the East China cities, including Shanghai and Nanjing, where a severe coal shortage had resulted in a drastic power cut last winter, railway transportation is not expected to improve very quickly.

In a bid to find a solution to the problem, the Ministry of Railways and the Ministry of Communications decided in 1982 to develop shipping facilities along the Huang He. A feasibility study was later conducted by experts of the ministries on a program to tranship coal from mines in western Henan, southern Shanxi, Shaanxi, and other West China provinces by rail to Zhicheng Harbor in Hubei Province and then by water to cities in East China or abroad. On the basis of this study, developments started the next year.

As a part of the program coal wharves have been built at the loading port of Zhicheng and the transshipment port of Nantong along the Huang He, while the Jiaozuo (Henan) -- Zhicheng (Hubei) railway has been expanded for the same purpose.

The first shipment of 20,000 tons of coal undertaken by the newly formed Tongyuan Shipping Company arrived in nantong from Zhicheng last week. The company is jointly run by the Ministry of Coal Industry and Wuhan's Huang He Shipping Corporation under the Ministry of Communications.

CSO: 4010/134

COAL

COAL MINISTRY EARMARKS FUNDS FOR NEW RAILROADS, WHARVES

OW181129 Beijing XINHUA in English 1121 GMT 18 Mar 85

[Text] Beijing, 18 Mar (XINHUA)--The Coal Ministry plans to spend 2.2 billion yuan over the coming 5 years to build new railways and wharves to improve coal transportation.

The money will come from the total government investment of 31.5 billion in the industry during the Seventh Five-Year Plan (1986-1990).

Coal Minister Gao Yangwen told a national conference on the industry now in progress here that the money would be used to build railways in central and southeastern Shanxi Province and northern Shaanxi Province and coal wharves in coastal cities.

According to officials from Shanxi, China's leading coal producers, only 124 million of the 187 million tons mined there last year were transported out.

Shanxi's pithead stocks swelled to more than 30 million tons last year--the largest stockpiles in the country.

Meanwhile, energy-thirsty cities in the east are crying out for more coal. Energy shortages have hit production at factories in northeast China and along the coast.

Gao said this underlined the importance of improving transport.

CSO: 4010/117

COAL

MORE SAFETY MEASURES TO BE ADOPTED BY NATION'S MINES

OW081153 Beijing XINHUA in English 0648 GMT 8 May 85

[Text] Beijing, 8 May (XINHUA)--More safety measures will be adopted by China's coal mines this year, said Vice-Minister Ye Qing at the national conference on controlling industrial dust and poisons which ended here Tuesday.

Accidental deaths in large and medium-sized state-run mines have fallen about 10 percent annually in recent years, he announced.

A national campaign among 4 million coal miners this month will concentrate on measures to control dust and gas.

The ministry has spent 3 million yuan each year since 1982 to improve mine dust control systems, Ye said.

Ministry statistics show that 80 percent of the bigger mines have dust control networks. Almost 9,000 kilometers of mine tunnels have water sprayers that reduce air-borne dust. Inspectors numbered 11,300 by the end of 1984.

However, Ye said, a number of mines still have a dust density higher than the state standard of 2 to 10 mg per square meter.

Many rural pits need to install safety facilities and spread technical knowledge about safe operations among the miners.

Ye Qing said that contracts specifying production responsibilities of each coal mine must provide protection. No new project will be allowed to go into operation without adequate dust and poison control installations.

He also urged installation of monitoring and ventilation systems, training of safety specialists and regular check-ups and medical treatment for coal miners against silicosis.

CSO: 4010/138

COAL

BRIEFS

FIRST QUARTER PRODUCTION EXCEEDS QUOTAS--Beijing 9 Apr (XINHUA)--China cut 191 million tons of coal in the first quarter of this year, a 10.3 percent increase over the same period last year, the Ministry of Coal Industry said here this afternoon. State mines produced 102 million tons, 6.01 million tons over quota. Mines run by local governments, collectives and individuals turned out over 89 million tons, a much greater increase than state mines. Ministry departmental director Wang Jichi attributed the rise chiefly to miners' productivity under the responsibility system. Also, said Wang, all mines had finished preparatory work such as tunneling, examining and repairs, ensuring smooth growth of this year's production. [Beijing XINHUA in English 1234 GMT 9 Apr 85 OW]

JIANGXI CONTRACT SYSTEM APPROVED--A request by the provincial Department of Coal Industry for initiating a fixed input and output contract system in major coal industries in the province has been approved. The new contract system provides that the annual quotas set for those enterprises in coal output, capital construction, investment, and allowed financial loss shall remain unchanged for 6 years beginning in 1985. Coal mines of which output is subject to unified state distribution shall increase their output at an annual rate of 3.45 percent, with the 1984 output of 6.25 million metric tons as the base figure. Coal mines under the provincial Department of Coal Industry shall increase their outputs at an annual rate of 2.03 percent, with the 1984 output of 2.96 million metric tons as the base figure. [Text] [Nanchang Jiangxi Provincial Service in Mandarin 1100 GMT 8 May 85]

GANSU DEVELOPS LOCAL MINES--The provincial coal industry corporation decided yesterday to allocate 1.648 billion tons of coal reserves to be exploited by towns, townships, and masses in and outside of the province. According to the survey, the total coal reserves of the province is 6.57 billion tons. There are 380 coal mines of large, medium, and small scale. But these abundant local coal reserves have not been made full use of. Thus the provincial people's government decided to expedite the development of coal mining to meet market demand. The coal reserves allocated to the public by the provincial coal industry corporation accounts for 26.7 percent of the province's total coal reserves. [Summary] [Lanzhou Gansu Provincial Service in Mandarin 2300 GMT 24 Apr 85 HK]

SHANDONG FIRST QUARTER PRODUCTION--Local collieries in Shandong Province overfulfilled first quarter raw coal production plan 7 days ahead of schedule. As of 24 March, a total of 2.532 million tons of raw coal had been produced, overfulfilling the first quarter production plan by 22,000 tons, an increase of 5 percent over the corresponding period in 1984. [Excerpt] [Jinan Shandong Provincial Service in Mandarin 2300 GMT 29 Mar 85 SK]

JILIN FIRST QUARTER PRODUCTION--Local state-run collieries in Jilin Province produced 933,600 tons of raw coal in the first quarter of this year, overfulfilling by 11.3 percent the assigned quota and increasing by 94,600 tons over that of the same period of last year. [Excerpt] [Changchun Jilin Provincial Service in Mandarin 1030 GMT 11 Apr 85 SK]

FOREIGN ASSISTANCE SPURS CONSTRUCTION--Beijing, 26 March (XINHUA)--China is constructing and expanding 130 underground and opencast coal mines with a combined annual output capacity of over 131 million tons, a coal ministry official said today. Bi Kongsi, a deputy department director, said the mines were scattered across 21 provinces, municipalities and autonomous regions. Twenty-two of them, with an annual capacity of 15.1 million tons, will be put into operation before the end of this year. In addition, construction or expansion work at another four major pits and one opencast mine will also begin this year. Bi said they were now concentrating on the expansion of existing mines. The number of mines being expanded accounts for 26.5 percent of this year's construction program -- seven percent higher than in 1984. Meanwhile, as a result of the adoption of the responsibility system, he said, the construction period for each major new mine averaged 76 months in 1984, 12 months shorter than in 1983. He said international cooperation on coal mining in China was on the increase. World Bank and Japanese loans were being used for construction work, and the United States, the Federal Republic of Germany, Britain, and Japan were helping with tunneling, feasibility studies, and management. [Text] [Beijing XINHUA in English 0803 GMT 26 Mar 85]

WESTERN HEILONGJIANG STRIKE--Harbin, 20 Apr (XINHUA) -- A coal field with reserves of several hundred million tons of high-quality fuel has been discovered by geologists in northeast China's Heilongjiang Province. The shallow-seam coalfield, covering 400 square kilometers in the province's western Heihe District, is suitable for opencast mining, said local officials. Once developed, the field will ease the local shortage of fuel, thus promoting development in the province, the officials added. [Text] [Beijing XINHUA in English 1219 GMT 20 Apr 85 OW]

HEBEI DRESSING PLANT OPERATIONAL--Shijiazhuang, 9 May (XINHUA)--A coal dressing plant with an annual capacity of 1.8 million tons officially went into operation in Hebei Province this week. The Dongpang Coal Dressing Plant was a key national project during the Sixth Five-Year Plan period (1981-1985) and will help improve the coke and fuel supply in north China. [Text] [Beijing XINHUA in English 1924 GMT 9 May 85]

BORXIL MINE EXPANSION--Hohhot, 18 May (XINHUA)--A mechanized open-cast coal mine in northeastern Inner Mongolia is being expanded to produce 600,000 tons of high-quality brown coal a year. The Borxil mine, with a verified coal reserve of 10.4 billion tons, is located on the Hulun Buir grasslands, where the simple geological structure makes for relatively easy extraction. It is scheduled to be completed in 42 months. [Text] [Beijing XINHUA in English 0643 GMT 18 May 85 OW]

HEILONGJIANG ADDS NEW MINES--Harbin, 9 May (XINHUA)--Heilongjiang, one of the country's major coal production centers, expects output to rise one-fifth. Mines now adding 26 pairs of coal shafts in the northern province have a combined production capacity of more than 10 million tons. The province produced 56 million tons last year. All 26 new mines are in the new mining area in eastern Heilongjiang. Construction of 16 began last year. This year, the state and locality have spent more than 500 million yuan on 10 others. Two are expected to go into operation by the end of this year. The rest are scheduled for completion by the year 1989. [Text] [Beijing XINHUA in English 1059 GMT 9 May 85 OW]

CSO: 4010/147

OIL AND GAS

DAQING SET TO BREAK 1984 RECORD OUTPUT

HK310444 Beijing ZHONGGUO XINWEN SHE in Chinese 0824 GMT 28 Mar 85

[Report: "Daqing Marches Forward Steadily in the Course of Reform"]

[Text] Beijing, 28 March (ZHONGGUO XINWEN SHE)--Chen Liemin, an NPC deputy attending the Third Session of the Sixth NPC here and secretary of the Daqing Oil Field CPC Committee, told reporters that the Daqing Oil Field is marching forward steadily in the course of the economic reform. It has had an annual production of 50 million tons of crude oil for 8 consecutive years, with a record high production of 53.56 million tons last year. It is scheduled to produce 55 million tons this year. The Daqing Oil Field can maintain a steady output until the 1990's.

Daqing is China's biggest oil field. Since it was set up in the 1960's, it has produced a total of over 730 million tons of oil and has delivered over 68 million yuan to the state. Last year alone, it delivered 4.2 billion yuan.

Chen Liemin said that the economic reform has given Daqing unlimited vitality. Like all big enterprises throughout the country, Daqing has also been given very great decisionmaking power. Since 1981, Daqing has practiced the contract system in production at all levels. According to relevant stipulations, 80 percent of the funds from crude oil output in excess of production targets (according to the price of crude oil in the international market) can be retained for Daqing's own use. Thus, Daqing has ample funds for developing new oil zones.

At present, Daqing, which is famous for its "self-reliant" spirit, has also taken a relatively big step forward in opening to the outside world and in importing technology. In the past few years, Daqing has used loans from Japan, the United States, and the Bank of China, amounting to $900 million, to import more than a dozen sets of modern drilling machines from the United States and more than a dozen sets of well-logging equipment, and over 1,000 sets of electric oil pumps from France. Daqing has also employed a U.S. seismic team, which has found several hundred structures deep in the oil field and on its edges. These structures cover an area of over a thousand square kilometers, pushing forward the work of finding new oil-bearing formations.

In the past few years, the living standard of the workers and staff members of Daqing has greatly improved. Forty percent of the workers and staff members have moved into new houses and scientific and technical personnel at the level of engineers or above are basically living in three-story houses.

CSO: 4013/118

OIL AND GAS

FOREIGN COMPANIES INVITED TO EXPLOIT ONSHORE OIL

OW011021 Beijing XINHUA in English 0646 GMT 1 Apr 85

[Text] Beijing, 1 Apr (XINHUA)--Foreign companies will be invited to exploit onshore oil in ten south China provinces, a spokesman for the Ministry of Petroleum Industry announced here today.

These are Jiangsu, Anhui, Zhejiang, Fujian, Hunan, Jiangxi, Yunnan, Guizhou, and Guangdong Provinces and Guangxi Zhuang Autonomous Region.

The Ministry of Petroleum Industry has authorised the China National Oil and Gas Exploration and Development Corporation as the Chinese authority.

China and over 30 foreign oil firms have concluded agreements on joint exploration and development of offshore oil resources since 1980.

CSO: 4010/117

OIL AND GAS

COUNCIL APPROVES JOINT ONSHORE OIL EXPLORATION

OW051742 Beijing XINHUA in English 1603 GMT 5 Apr 85

[Text] Beijing, 5 Apr (XINHUA)--There are 1 million square kilometers of oil-bearing sedimentary structures spread among 10 southern Chinese provinces and regions, offering bright prospects for future oil development, according to a Chinese official.

Speaking at a news conference here today, Li Xianglu, vice-president of the China National Oil Development Corporation (CNODC), said that test drillings had already confirmed the presence of oil in Jiangsu and Anhui provinces, as well as in the Guangxi Zhuang Autonomous Region and Hainan Island in Guangdong Province.

The other oil-potential provinces are Zhejiang, Fujian, Hunan, Jiangxi, Yunnan, and Guizhou.

The Chinese Government recently announced that it is ready to cooperate with foreign companies in the exploration and exploitation of these on-shore districts, which cover an area of 1.83 million square kilometers.

According to Li, oil company representatives from the United States and Japan have already made inspection tours of the 10 provinces and regions.

As a state enterprise, CNODC, formerly the China National Oil and Gas Exploration and Development Corporation, will handle on-shore exploration.

In order to speed cooperation, Li said, CNODC will hold direct negotiations with foreign firms instead of using the bidding system common in off-shore operations.

At present, he said, negotiations are underway with about 20 foreign oil companies, and others are welcome.

CSO: 4010/124

OIL AND GAS

SINO-U.S. WELL MOST PRODUCTIVE IN PEARL RIVER BASIN

HK160717 Beijing CHINA DAILY in English 16 Apr 85 p 1

[By staff reporter He Qide]

[Text] Guangzhou--Completion of test drilling on the fifth foreign contracted offshore oil well in the Pearl River Mouth Basin has revealed it to be the most productive there so far, it was announced here at the weekend.

The Xijiang 24-3-IAX well, located in 96 meters of water about 130 kilometers southeast of Hong Kong in the South China Sea, tested oil from three separate zones below 1,920 meters totaling 922 tons of crude oil per day.

This is the highest output of the five wells run in cooperation with foreign companies in the basin, Wang Tao, general manager of the Nanhai East Oil Corporation, told a press conference.

The well was the first drilled in the Sino-American contract area 15/II which Phillips Petroleum International Corporation Asia and Pecten Orient Company acquired in January 1984. Phillips is the operator of the block and has a 50-percent interest. Pecten also has a 50-percent interest, Wang said.

All operations in the block are run in cooperation with the China National Offshore Oil Corporation [CNOOC] and Nanhai East Oil Corporation, said the general manager.

Wang also disclosed that 18 wells had been planned for drilling this year in the eight contract areas in eastern part of the South China Sea.

Analysis of the geological conditions suggests there are more wells with higher yields to be found and opened up in the Pearl River mouth basin, said Wang.

CSO: 4010/131

OIL AND GAS

SINO-U.S. CENTER FOR GEOPHYSICAL DATA OPENS

OW162208 Beijing XINHUA in English 1649 GMT 16 May 85

[Text] Guangzhou, 16 May (XINHUA)--A Sino-U.S. center was inaugurated Wednesday in Zhanjiang, Guangdong Province, to provide seismic data for foreign and Chinese oil companies operating in the South China Sea.

The Nanhai Occidental Physical Survey Cooperation and Processing Center was set up by the Nanhai Western Petroleum Corporation of the China National Offshore Oil Corporation and the Occidental Geophysical Survey Corporation of the United States.

The American partner will supply computer software and hardware to the center, to be run jointly for 5 years.

CSO: 4010/141

OIL AND GAS

CNPC SUBSIDIARY STARTS OWN FIELD DEVELOPMENT

OW162056 Beijing XINHUA in English 1836 GMT 16 May 85

[Text] Guangzhou, 16 May (XINHUA)--China has begun developing its own offshore oilfield in Beibu Gulf of the South China Sea, with drilling of a new well started Sunday.

Offshore oilfields were previously exploited by Chinese companies in cooperation with foreign firms.

The new well is in the Wushi 16-1 oilfield, the second developed in the South China Sea. Drilling is being done by the Nanhai Western Petroleum Corporation, a subsidiary of the China National Petroleum Corporation.

Drilling of another well is to start soon. Wushi is believed to have large oil reserves. An exploratory well there produces a high yield of 600 cubic meters of crude oil daily.

CSO: 4010/141

OIL AND GAS

PETROLEUM POTENTIAL OF TARIM BASIN DEPRESSIONS DISCUSSED

Jiangling SHIYOU YU TIANRANQI DIZHI [OIL AND GAS GEOLOGY] in Chinese Vol 5, No 3, Sep 84 pp 277-284

[Article by Zhou Chaoji [0719 2600 3444] and Jiang Jianhang [1203 1696 5899], of the Second Drilling Headquarters of the Southern Xinjiang Petroleum Administration: "The Petroleum Potential of Three Major Depressions in the Tarim Basin"]

[Text] The area of the Tarim Basin is 560,000 square kilometers and the diamond-shaped fault block structural configuration is formed and controlled by the two intersecting rifts in the northeast and the northwest (see Fig. 1).

The Tarim movement near the end of the Proterozoic Era formed the platform at Tarim. During the Paleozoic Era, the northern and southern sides of the basin were respectively the Kunlun geosyncline and the Tian Shan geosyncline, and the interior was a marine facies platform deposit. The Variscan movement at the end of the Paleozoic Era caused the recession of the sea, the geosynclines to the north and to the south folded into mountains and separated from the basin by deep rifts, and the lateral structural system of the basin's perimeter was formed. At the same time, the interior of the basin began to develop two groups of base rifts along the northeast to north-by-northeast and the northwest to north by northwest directions and formed periodic rises and depressions. In the Mesozoic Era the Indochina and Yanshan movements associated with the compression between the Tethys ocean shell and the Eurasian continental shell generally lacked the Triassic system in the Tarim region with the exception of the Kuqa depression and the eastern Tarim depression. The activity was mainly the up and down movement of the depression but the eastern Tarim depression may be an inland rift valley. In the late Cretaceous Period and the early Tertiary Period, sea water invaded the southwest region. In the late Eocene Epoch the Indian plate collided with the Eurasian plate and sealed off the Tethys sea. Under the compression, Kunlun and Tian Shan rose rapidly and caused the deep Tertiary deposit in the basin, the center of deposit shifted from the front range to the interior of the basin and the faults were unified into depressions. Under the strongly compressed environment, the folding was more severe in the front range where the rift overthrusts were more developed and the changes were opposite toward the center of the basin. The compression and twisting caused by the collision of the plates led to rifts

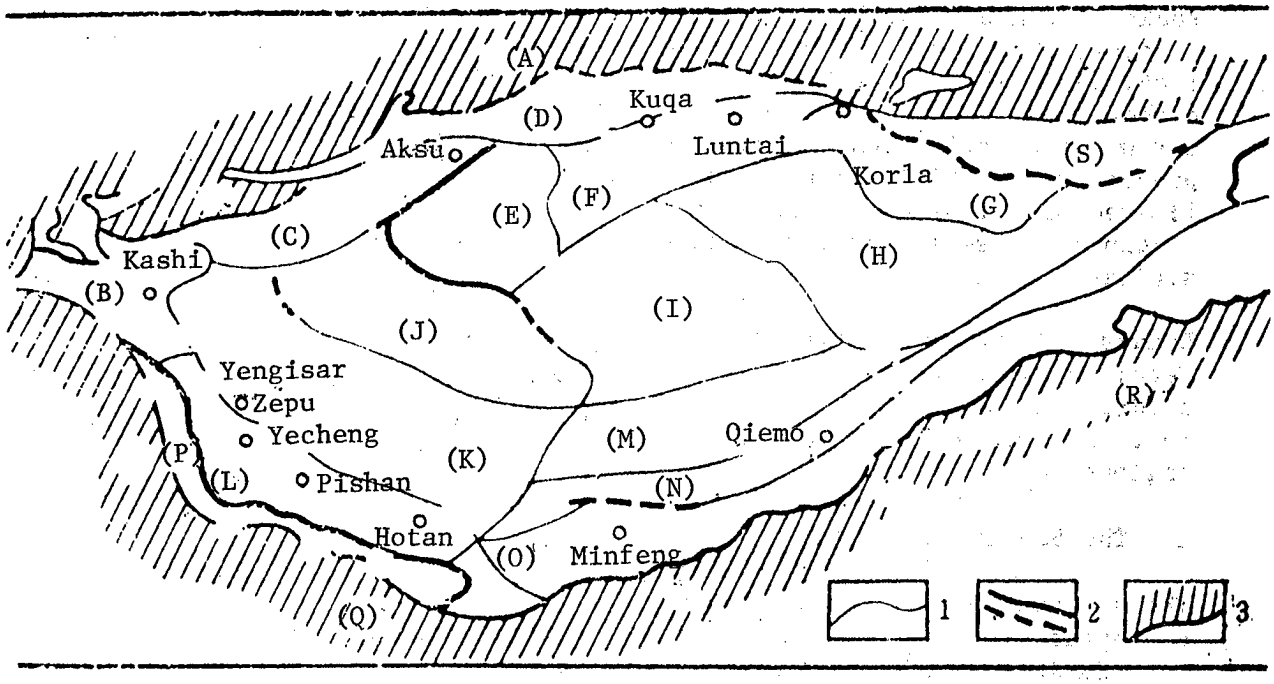


Figure 1. Structural map of the Tarim Basin
(1) Boundary of structure units, (2) Fault, (3) Boundary of geosynclines

KEY:
(A) Tian Shan geosyncline
(B) Kashi subdepression
(C) Keping platform bulge
(D) Kuqa subdepression
(E) Awat indentation
(F) Northern Tarim platform bulge
(G) Kongquehe platform
(H) Manjia'er indentation
(I) Central platform bulge
(J) Bachu platform bulge
(K) Markit slope
(L) Yecheng subdepression
(M) Tanggusibasi terrace
(N) Qiemo platform bulge
(O) Yutian Ruoqiang subdepression
(P) Tikelik platform bulge
(Q) Kulun geosyncline
(R) Altun block fault zone
(S) Kuruktag platform bulge

in the perimeter and the interior of the basin and caused the lower order folds to adopt "S"-shaped, reverse "S"-shaped and lambda-shaped configurations.

There are three sets of oil producing rock series in the basin. The Carboniferous system and the lower Permian series are mainly widespread marine facies carbonatite and fragmental rocks. The upper Triassic series and the middle and lower Jurassic series distributed in the front range depression and the eastern Tarim region are a series of continental facies coal-bearing and oil-producing structures. The upper Cretaceous series and the loser Tertiary system are limited to the southwest region of the basin and consist of alternating layers of marine facies carbonate and argillaceous rocks. According to analyses made by the Lanzhou Geological Institute of the Chinese Academy of Sciences, the dark Jurassic argillaceous

rocks have great thickness, and are well transformed and rich in organic content. They are in the oil-generation period but distribution is relatively localized. The carbonate and the dark argillaceous rocks of the carboniferous system and the lower Permian series have a lower organic content but wider distribution and great depth, they have the greatest oil and gas producing potential. The upper Cretaceous series lower Tertiary system has limited distribution of oil-producing rocks, the organic content is low, the thickness is small and their oil and gas prospects are poor, based on available data.

Because of the large area of the basin, the great thickness of the upper Tertiary system (a maximum thickness of 8000-10,000 meters), and the poor natural and geographic environment, the degree of prospecting is still very low. In this paper we evaluate the oil and gas prospects of the three major regions in the basin.

I. The Southwestern Depressions

The southwestern depression consists of three structural units, the Kashi subdepression, the Yecheng subdepression and the Markit slope. After the western Kunlun and Tian Shan folded into mountains in the late Permian Period, the Mesozoic Era in this region was dominated by depression sediments but the Triassic system was missing. During the Himalaya movement in the late Eocene Epoch to Oligocene Epoch, the Indian plate first collided with the Eurasian plate and led to strong mountain formation on the perimeter of the basin. At the same time, western Kunlun began its transformation into the Pamir arc and gradually sealed off the western end of the Tarim Basin, causing the faults to become depressions. The extensive Cenozoic deposition, the displacement of the deposition center, the fault activities, and the spreading of the structural layout are all intimately tied to this movement and play a controlling role of the oil and gas movement, accumulation, and distribution.

(1) The stress field and local structures of the southwestern depression

The western Kunlun originally extending in an east-west direction was transformed into the Pamir arc. The arc has the shape of a reversed "S" and was produced by the clockwise rotational stress field caused by the strong collision between the Indian and the Eurasian plates. For example, gravitation and magnetism data have shown that Qimugen, Tikelik, and Beiminfeng [Northern Minfeng] were originally the high gravity belt at the front edge of the land mass, but this belt was forcibly stretched into three sections. The western section at Qimugen and the eastern section at Beiminfeng suffered a 100-130-kilometer dislocation to the north relative to the central Tikelik section, which slid in the opposite direction. Along the Yarkant He from Zepu to Seribuya, the gravitational anomaly line showed a produced kink and the magnetic anomaly line had a 40-50-kilometer dislocation (see Figure 2).

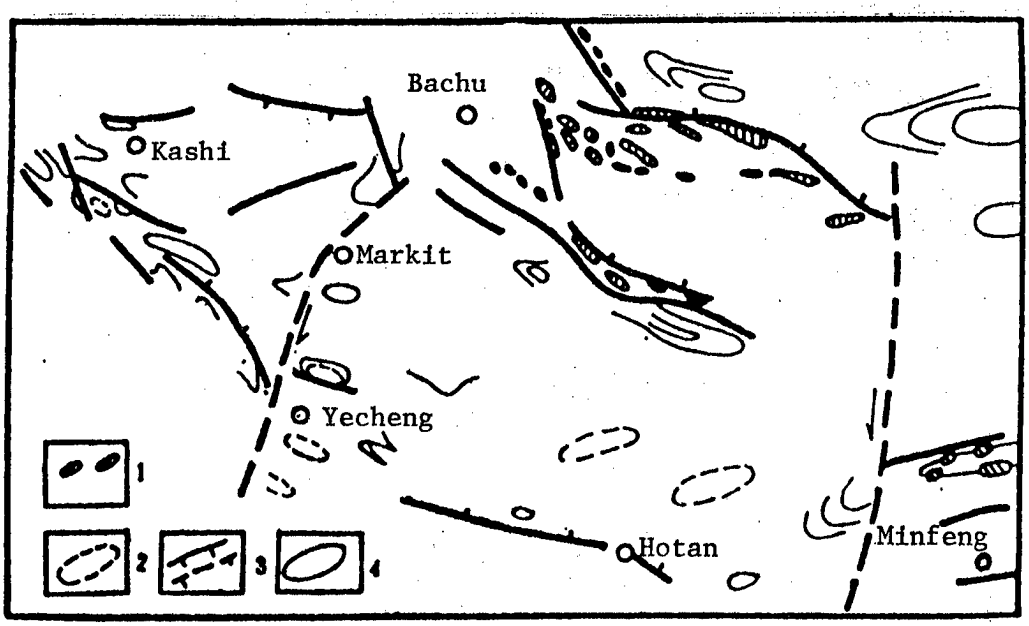


Figure 2. Local rift structures and gravitational and magnetic anomalies of the southwest depression of the Tarim Basin (after Zhang Yaorong 1980, with slight modification).

KEY:
1. Linear chain magnetic anomaly
2. Local weak magnetic anomaly
3. Steep gradient of gravitational anomaly
4. Local high gravity anomaly

These are not isolated phenomena, they are instead the natural results of the horizontal compression force produced by the collision of two plates and acting on the interior of the Tarim land mass[1].

The stress field distribution of the southwestern depression was influenced mainly by three rifts. Northern Tian Shan and southern Kunlun each have a compression rift in the eastwest direction parallel to the mountains. The rift to the west along the Pamir arc and extending in the west by northwest direction is a compressive twist rift. They not only control the boundary of the depression and the associated stress field, but also control the layout characteristics of lower order structures in the Kashi subdepression and Yecheng subdepression (see Figure 3).

The Kashi subdepression is divided into three secondary structural belts: the pre-Tian Shan anticline, the pre-Kunlun anticline and the eastern Kashi anticline. The first two are controlled mainly by the compression force; the folds are linear, closely spaced and parallel to the boundary of the old mountains. The axes have exposed Jurassic system, Cretaceous system, and Miocene series of the upper Tertiary system. The third belt is mainly controlled by the compressive tilt faults in the west, the folds converge to the west and open to the east. The pattern is a right-justified λ shape, the configuration is a prolate box and the axis has exposed Tertiary system.

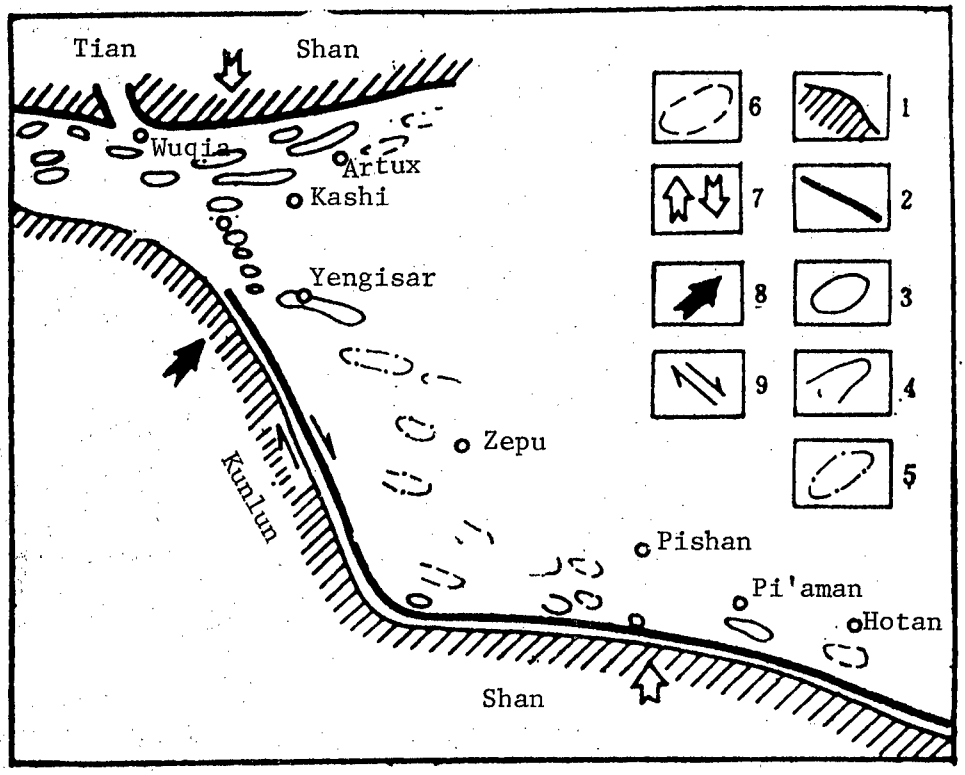


Figure 3. Stress field and local structures in the southwest depression zone (after Jiang Shenbang 1981, with slight modification).

KEY:
1. Perimeter mountain ranges
2. Surface rift
3. Surface anticline
4. Surface nose structure
5. Local structure (aeromagnetic survey)
6. Local seismic structure
7. Compression stress
8. Rotational buckling stress
9. Compressive buckling stress

The Yecheng subdepression has a three-row structure. The first two rows were first controlled by the compressive force of the Kunlun Mountains and are still characterized by developed rifts and strong folds. The southern wing is gradual and the northern wing is steep. During the Xishan movement at the end of the Tertiary period, the west Kunlun made a clockwise rotation to the north, and under the action of the compressive torsional rifts, the three rows formed a left-justified λ-pattern, diverging to the west and converging to the east. The axis of singular structures also showed pronounced twist to the north and west. Since the compressive stress occurred prior to the compressive torsional stress, and because the compressive torsional stress gradually decreased from west to east, the Yecheng subdepression still shows a downward tilt from east to west in each row and the exposed strata in the west are newer than those in the east.

Based on the analysis above, the structures closer to the mountains in the two depressions were formed earlier and those farther away from the mountains were formed later. Structures formed by compressive stress were earlier than those formed by compressive torsion stress.

(2) Geological conditions for secondary oil deposit formation in the southwestern depression zone

In this region there are three oil-generating rock systems. Based on source rock compression studies, the oil seepage and crude oil generated in the Karato anticline and the Yangye anticline in the Kashi depression may have originated from the continental facies source rocks in the Jurassic system. The crude oil generated in the Miocene series strata in the Kokuy oil field in the Yecheng depression is a highly mature crude oil and may have originated from the source rocks of the Carboniferous system and the low Permian series. Therefore, both the widespread oil seepage of the Tertiary system and the upper Tertiary crude oil coming from the wells are believed to have migrated up from the underlying source rocks and structures.

Throughout the area there are thick deposits of non oil-producing upper Tertiary sediments. According to seismic data, the sedimentation center of the upper Tertiary sediments in the Kashi depression is located near Kashi and the thickness is 10,000 meters. In the Yecheng depression the sedimentation center moves from south toward north due to the continuous rise of the Kunlun Mountains and the northward motion of the Pamir arc. The early Tertiary Period sediment center is south of Guman, the late Tertiary Period sediment center is at Guman, and subsequently moved to the vicinity of the Yecheng-Pishan highway north of Guman. The upper Tertiary system has a thickness of 8000 meters at the sedimentation center. Due to the great thickness, we were unable to drill into the deeply buried primary oil deposit at most locations in this area. We could only explore the secondary oil deposit in the Tertiary system and some of the crude oil might even be formed in the second oil formation.

The Kokuy oil field in the Yecheng depression is evidently a secondary oil deposit. The structure and growth of this field can best explain the geological conditions for secondary oil deposit formation. First, a rift developed on the north wing of the oil field. The rift is from the lower Tertiary system to the middle lower portion of the Miocene series but the cover stratum is still intact. There are five underlying faults from the Carboniferous system to the Permian system, all of them channels for oil and gas transport. Second, the oil field structure was formed during the early Miocene epoch when the depth of the underlying Jurassic system or Carboniferous-Permian system oil-generating rocks was about 2,500 meters and the oil-generating threshold was exceeded. As the deposit of the Miocene series continued, the depth of the oil-generating rocks increased and the magnitude of the anticline structure also increased. The oil and gas generated gradually shifted into the trap. Third, seismic data showed that the underlying Carboniferous-Permian system and the overlying Miocene series deposit have basically the same structure and the oil and gas in the underlying structure moved into the overlying structure by various routes.

(3) Evaluation of oil and gas prospects

The oil-generating rocks in the southwest depression are mainly the Carboniferous-lower Permian system, followed by local distributions of middle and lower Jurassic series and marine facies upper Cretaceous series lower Tertiary system. The collision of the Indian and Eurasian plates had a great influence on the generation, transport, deposit, and destruction of oil and gas in this region. First of all, the settling of the Tertiary system closely associated with the plate movement caused the oil generating strata deeply buried. The depth of the target strata in the survey--the Miocene series--was increased and the area for prospecting was greatly reduced. Second, the compressive stress and the compressive torsional stress generated in the plate collision formed different structures at different times. This caused temporal and spatial scattering of oil generation, transport and deposit. We now evaluate the various regions.

1. The third row structure of Yecheng depression was greatly influenced by the second stage of the upper Pleistocene Heimalaya movement. The structure was formed late in time, close to the sedimentation center of the upper Tertiary system and the cover stratum has a great thickness. These are all unfavorable conditions for oil formation and prospecting. The second row structures were generally formed during the first and second stage of the Xishan movement. The structural continuity and consistency, the early formation time before the secondary oil generation period, and the formation under the compressive torsion stress are all favorable conditions for oil and gas deposit. The Kokuy oil field is located on the second row structure. The first row structure was formed early in time and suffered more damage. But the depths of the oil deposits are relatively shallow and the first row structures are still favorable locations for prospecting primary oil.

2. The anticline zone in the Kashi depression was formed under compressive stress, and severe damage has led to widely scattered oil and gas. However, some structures in the Kashi anticline share the same geological characteristics as the second row of the Yecheng depression, they are therefore favorable locations for oil prospecting. Anticlines near the upper Tertiary sediment center are not favorable locations for oil and gas prospecting because the cover strata are too thick.

3. The Markit slope is a monocline tilting toward the southwest. It consists of marine facies Carboniferous-Permian and the Cretaceous-lower Tertiary system and continental facies upper Tertiary system. The stratum thickness gradually decrease from south to north and from west to east. Although local structures on the slope are not well developed, stratigraphic trap oil and gas deposits may be formed.

II. The Kuqa Depression

The Kuqa Depression is a southern Tian Shan frontrange depression developed on the basis of the Haixi fold. The area is about 30,000 km^2. The (Ehuobulake) group in the lower Triassic series and the (Biyoulebaoguzi) group in the upper Permian series are in conforming contact, but the upper Permian series and the underlying Paleozoic group are in nonconforming contact, indicating that the main event of the variscan [movement] occurred

during the end of the early Permian period. The vertical movement of the rise of the Mesozoic Era Tian Shan fold and the fall of the frontrange depression was caused by the horizontal movement associated with the collision between the Tethys ocean shell and the Eurasian continent. Subsequently, the violent squeeze and collision between the Indian plate and the Asian plate transformed the Mesozoic depression at Kuqa into a Cenozoic depression.

The maximum deposit thickness of the Cenozoic group continental facies stratum in the Kuqa depression is 10,000 meters. The surface has a rich distribution of oil and gas seepage and exploratory drilling showed encouraging indications. Although the seepage and indications came from different strata and systems, studies have shown that the source rock is the Jurassic system. For example, the Yiqikelik oil field is a spontaneous generation and deposit Jurassic oil field.

The Cenozoic strata in the Kuqa depression are thick and have no oil-generating stratum. The oil storage capacity is poor and the lower portion has salt strata. The target stratum in the prospecting is therefore the Mesozoic group, especially the primary oil deposit in the Jurassic system. Since nonconformity exists between the Mesozoic and the Cenozoic groups, the key to the evaluation of oil and gas prospectus in this area is to assess the distribution range of the Mesozoic group and the accurage determination of the structure of the Mesozoic group.

According to seismic data, the Kuqa depression has four rifts down to the basement. Their direction is mostly east-west and they are controlled by the latitudinal structure of Tian Shan (see Figure 4).

The northern Bugulu rift is the northern boundary rift of the depression. The Paleozoic group to the north sometimes overthrusts the Cenozoic group to the south of the rift. The southern boundary is the hidden Luntai rift, to the south is the northern Tarim slope and the base rises toward the south through the rift. The Cangmuzituk rift in the interior of the depression runs in a west-by-northwest direction in the west and changes to east-by-northeast in the east. It forms an arch slightly bulging to the south and controls the area of the Mesozoic deposits. South of the rift the Mesozoic group is quickly pinched out. At the top of the arch where the rift makes a bend, the development of the Mesozoic group is the fullest and the thickness is the greatest. The Tuka rift is located to the north of the Mesozoic sediment center and has a direct influence on the enrichment and depletion of the oil and gas.

The Mesozoic Era in this region is dominated by rise and fall blocks. The three rifts in the frontrange described above may all have been normal faults in the Mesozoic Era. They influence the extend and thickness of the Mesozoic sedimentation. According to outcrop data in the north, the number of faults in the Mesozoic group is greater than that in the Cenozoic. For example, the Tugeerming anticline has 28 Mesozoic faults whereas the Tertiary system has only 17. Some of the faults disappeared in the Cenozoic group and others shortened their fault length. Seismic data also showed that the Mesozoic group under the Cenozoic group anticline and syncline has complicated block structure.

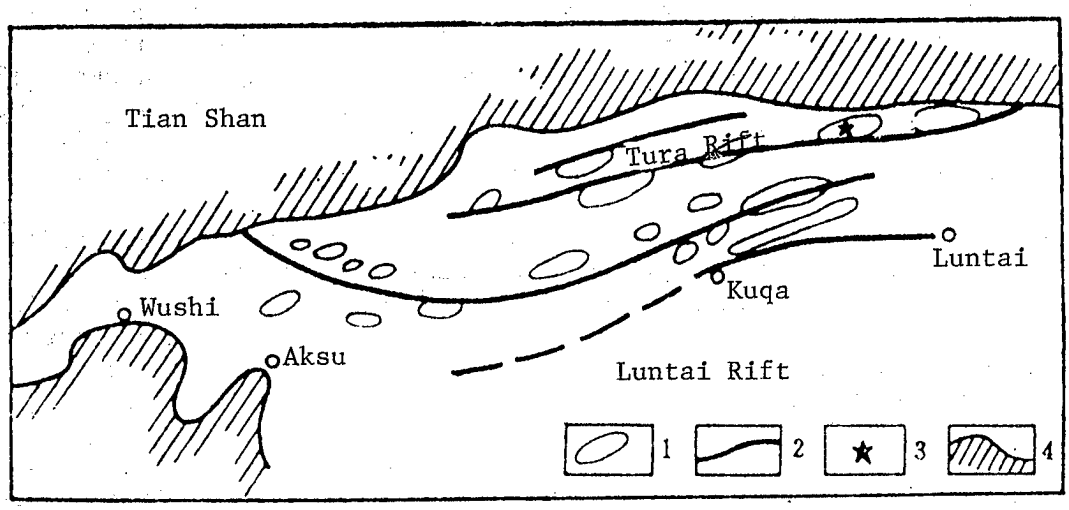


Figure 4. Local structures and rifts in the Kuqa depression
1. Anticline structure, 2. Rift, 3. Oil field, 4. Rise

The Yanshan movement not only led to rift activities in this region, but also caused the eastern and western parts of the depression to rise and produced missing strata or thinning out (see Figure 5). For example, the sediment center of the Cretaceous system is to the west of the Kezilenuer gully and the thickness reaches 1000 meters. However, the lower Cretaceous series from the Kezilenuer gully to the Yiqikelike anticline is only several tens of meters thick and the upper Cretaceous series is missing. Farther east, part of the middle Jurassic series and the entire upper Jurassic series and the Cretaceous system are missing at the southern wing of the eastern high point of the Tugeerming anticline. Most of the middle Jurassic series* is missing at Kuerchu.

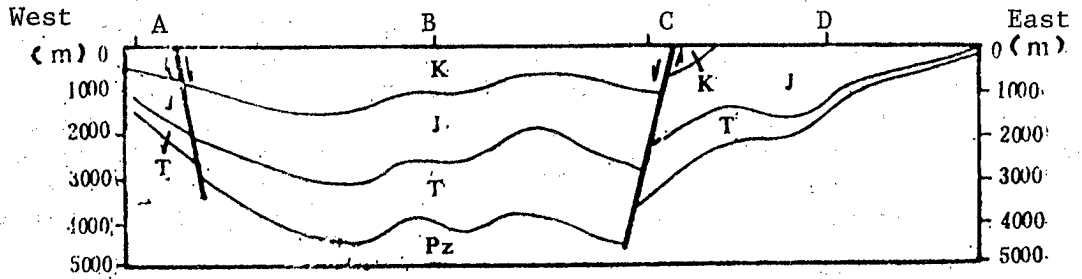


Figure 5. Cross-sectional view of the paleotectonic structure of the northern Kuqa depression

KEY: A. Taklak; B. Kelasuhe; C. Kezilenuerhe; D. Takelahe

*See Jiang Mingxin [1203 2494 2450], "Structural Characteristics and Oil and Gas Prospecting in the Kuqa Depression," 1980.

In the Xishan movement, the lateral pressure of Tian Shan to the south transformed the normal faults into reversed faults, depressions into subdepressions, and caused the deposit center to move through the Cangmuzituke rift and proceed southward to form four rows of structural belts along the rifts.

The first row is a monocline structure extended over a small area, the oil-generating rocks of the Tertiary system and the Jurassic system are all exposed and the oil and gas have escaped.

The second row is a linear anticline structure extending from Tugeerming in the east to Tuzimazha in the west. Most of the anticlines are linear, steep in the south and gradual in the north, and the southern wing is cut by faults. One of the branches of the Tuka rift developed in this area runs from Tugeerming to Yiqikelike and splits into two branches heading west, the northern branch cuts through the Bashijiqike anticline and the Kumugeliemu anticline and the southern branch cuts through the Jidike and the Kasangtokai anticline.

The Yiqikelike oil field on the eastern section of the second row has three high points and exposed Qigu formation of the upper Jurassic series on the axis. This structure was raised during the Yanshan movement in the early Cretaceous Epoch and favors the accumulation of oil and gas. The southern wing of the anticline is cut by the Tuka rift, the western high point fault passes through the vicinity of the axis and the oil and gas accumulation is much less than the tow high points to the east.

The third row is the Qiulitake anticline zone. The anticline is of the prolate box type, steep in the south and gradual in the north. The Cangmuzituke rift passes through the southern wing. Seepage shows good oil and gas deposits along this rift. The Kongcun and Jilishi seepages are producing several tens of kilograms per day. This rift is located on the south rim of the Mesozoic deposit center.

The fourth row is a zone of gentle folds in the south, mostly short anticlines with gradual wings. From the seismic data, it is possible that this zone is formed by the Tertiary system directly laying over the Paleozoic base. For example, drilling to a depth of 5,390 meters at the Yaken anticline only went through the top of the old Tertiary system.

The Cenozoic and the Mesozoic groups in this area have vertical nonconformity. It was discovered from seismic data that a Mesozoic group block fault existed between the Kasangtokai anticline and the Kumugeliemu anticline. A similar structure exists between the Yiqikelike anticline and the Qiulitake anticline in the east, as shown in Figure 6.

A number of reasons contributed to the nonconformity between the Mesozoic and the Cenozoic groups. First, the Mesozoic was influenced mainly by the Yanshan movement and dominated by rift activities. Because of the great depth, the horizontal squeeze of the Yanshan movement had a limited effect on the Mesozoic group. The Cenozoic group was formed later and had less

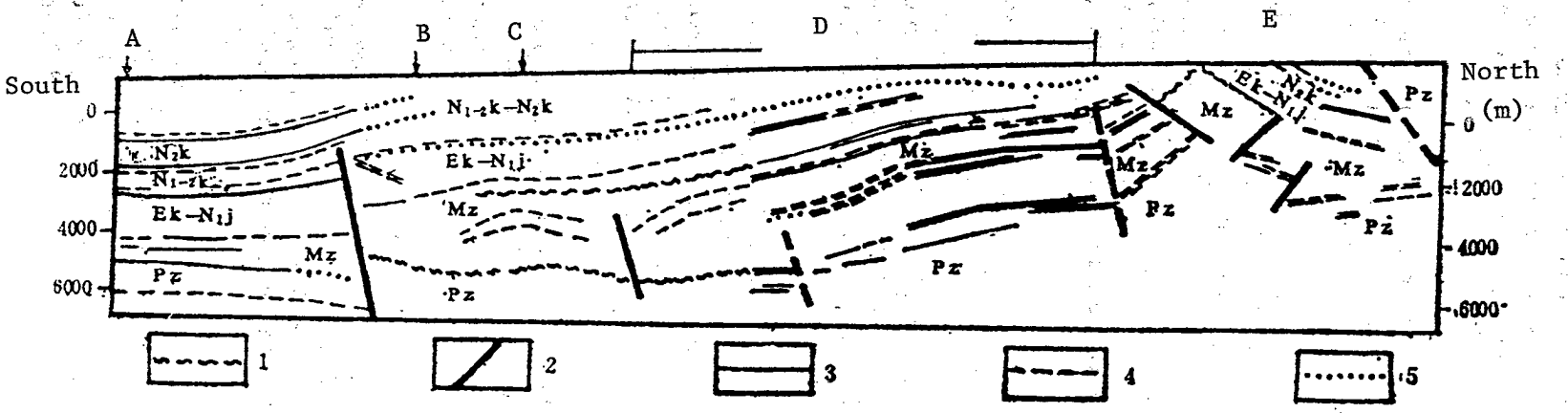


Figure 6. 78-84 Seismic cross-sectional view of the Kuqa depression
1. Boundary of nonconformity, 2. Boundary of fault, 3. Reliable seismic reflection boundaries, 4. Reasonably reliable seismic reflection boundaries, 5. Reference seismic reflection boundaries

KEY: A. Yaken anticline
B. East Qiulitake anticline
C. 84 inclosed rise
D. Yinan terrace
E. Yiqikelike anticline

rigidity and the horizontal squeeze had a great effect on it. Second, the two groups have different sedimentation centers. The center moves from north to south from the Mesozoic group to the Cenozoic group. Third, the Tertiary system Suweiyi formation ($E_3 - N_1S$) of salt strata in this region produced plastic flow under the horizontal stress and formed mostly salt domes and salt anticlines. The overlying stratum slid to the south along the salt stratum; for example, drilling has confirmed that the salt stratum's high point at the east Qiulitake anticline is located 2 kilometers north of the anticline axis.

Based on the discussion above, we propose the following strategy for prospecting:

1. The oil and gas are expected to be deposited in the subtle structures in the second and third rows. According to the petroleum formation theory, the oil generation threshold in the area should be about 2,500 meters. Therefore the major oil producing period of the Jurassic source rock in the Kuqa depression should be at the beginning of the Tertiary Period or the end of the Cretaceous Period. This was also the period when the Kuqa depression was formed under the influence of the Xishan movement. The inclosed structures between the second and the third rows are the most favorable locations for oil and gas accumulation because the Jurassic sedimentation center is to the south and the Tuka rift in the north prevented the migration of oil and gas to the higher northern part.

2. The Tertiary salt dome and salt anticline in the western part of the area have not received very much attention in the past because of their complex structure. Actually, the salt movement can only complicate the overlay structure and does not affect the underlying Mesozoic group. Possibilities exist for finding oil and gas if the Mesozoic structure under the salt stratum can be surveyed.

3. In the past the great northern Bugulu overthrust fault where the depression and the Tian Shan geosyncline meet is believed to be the boundary of Mesozoic sedimentation. However, substantial oil deposits have been found under the great overthrust fault on the western perimeter of the Junggar Basin, indicating that there are sedimentation basins under the so-called old mountains.

For example, on the east side of the Kezilenuer trench where the north Bugulu rift is located, the Paleozoic strata directly overthrust the Quaternary system Xiyu conglomerate rock formation (Q_1x), and yet the entire Mesozoic group is exposed at the northern anticline on the western side of the Kezilenuer trench. With some effort, we may find Mesozoic oil-producing strata and structures in the bottom wall of the reversed fault.

III. The Eastern Tarim Depression

The area of the eastern Tarim depression is about 120,000 square kilometers. It consists of two major structural units, the Awati identification in the northwest and the Manjiaer identation running in a west-by-northwest direction

in the eastern part of the depression. Between them is the northwest running Yaojin No 1 long wall. Some also include the northern Tarim slope and the Kongquehe slope into the eastern Tarim depression.

The Awati indentation is a low gravity zone centered at Awati. Its area is over 20,000 square kilometers. According to seismic data, the basement of the Cambrian-Ordovician system is about 12,000 m and the thicknesses of the middle Cenozoic group and the Paleozoic group are in the 5000-6000 meter range. Within the indentation, the strata are gradual and the thickness changes are small. There is no obvious sedimentation center. Below the reflection layer at the bottom of the Tertiary system (T_8), there is a 400-meter-thick reflection formation that gives strong and stable waveforms. The age of the reflection is equivalent to the Jurassic system and Triassic system[a] found at 4,063-4,570 meters in the Yaocan No 1 well and 4137-4710 meters in the Shacan No 1 well drilled along the northeastern edge of the Yaojin No 1 long wall.

According to the interpretation of the seismic data of the Awati indentation and the northern Tarim slope, the Carboniferous system in the Awati indentation is 2000 meters thick, the gravimetric altitude is 900 meters at Ketuer to the east, and 600 meters at Yaocan No 1. The Triassic bottom wall thickness at the Awati indentation fault is 3600 meters and the gravimetric altitude is 200-300 meters at Yakela to the east. Evidently the thickness of the Carboniferous-Permian system decreases rapidly from the Awati indentation to the east. Conversely, the Triassic-Jurassic system is only 400 meters thick at the indentation but becomes 1,100-1,200 meters at the Yaocan No 1 well to the east. In other words, it becomes thicker from west to east. Based on this, the thickness at the Manjiaer indentation should be over 2000 meters[b]. In addition, Jurassic system was found in Tie'nan No 1 and No 2 and in Anan No 1 and Ying No 1 wells. The thickness in Anan No 1 is at least 500 meters (not through). Therefore, the Manjiaer indentation should have a relatively thick Mesozoic erathem.

The Manjiaer indentation, with a west-by-northwest orientation, has an approximate area of 10,000 square kilometers. It is the place with the thinnest earth crust in the Tarim Basin, probably not more than 41 kilometers. The crust becomes thicker toward the perimeter and the thickness fluctuates greatly near the frontrange, to a maximum of 61 kilometers. Gravity and magnetism data showed that the magnetic anomaly and the gravitational anomaly led to consistent maximum height on the Mohorovicic surface, as shown in Figure 7.

---

a) Li Xibin [2621 1585 3453], "Dating of Mesozoic Strata in Shacan No 1 and Yaocan No 1 Wells," 1982.

b) Jiang Longlin [5592 7893 2651], "Tentative Interpretation of the Northern Tarim Basin Using Seismic Data," 1983.

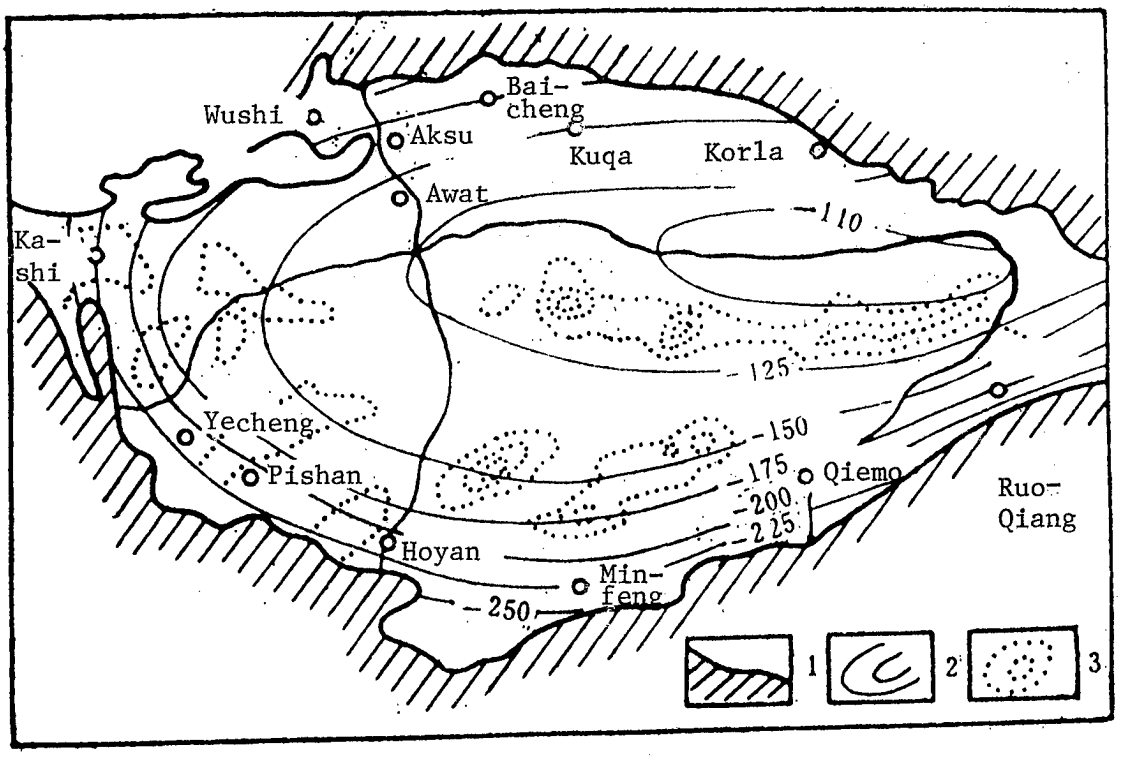


Figure 7. Overlapping map of gravitational and magnetic anomalies in the Tarim Basin
1. Basin perimeter, 2. Contour map of gravitational anomaly (in milligal), 3. Magnetic anomaly

In the meantime, the location of the deepest indentation of the crystalline base also coincides with the bulge on the Moho surface. Since the earth crust is thin and the mantle rises up, there should be a greater geothermal flow, which would favor petroleum formation by thermal dissociation. Based on the fact that oil fields have been found in the upper Triassic series and Jurassic system source rocks in the adjacent Kuqa depression and dark argillaceous rocks of the Triassic-Jurassic system have also been found in the wells drilled near the perimeter of the eastern Tarim depression, the well-developed Jurassic-Triassic system in this region may also be a source rock system. Undoubtedly the Manjiaer indentation and the adjacent northern Tarim slope are very promising regions for oil and gas prospecting.

The Kuqa depression part of this article benefitted from the advice of Mr Lu Jin [7627 2533] and the figures are prepared by Wang Yucheng [3769 3768 2052]. The author expresses his thanks to both of them.

REFERENCES

1. Huang Jiqing [7806 3078 3237], et al., "Geotectonic Structure and Evolution of China," Scientific Publishing Co., 1980.

2. Jiang Shengbang [3068 5110 6721], "Oil and Gas Prospectus in the Tarim Basin," Collection of papers on petroleum geology, Vol 1, Area Evaluation, Geological Publishing Co., 1981

3. Zhou Xingxi [0719 5281 3556], et al., "Secondary Oil Generation in Carboniferous System in Southwest Tarim Basin," Experimental Petroleum Geology, Vol 3, No 4.

4. Hu Boliang [5170 0130 5328], "Organic Geochemical Characteristics and Oil Sources in the Tarim Basin," OIL AND GAS GEOLOGY, Vol 2, No 4.

9698
CSO: 4013/22

OIL AND GAS

SICHUAN NATURAL GAS EXPLORATION AND PRODUCTION ENTERS NEW STAGE

Jiangling SHIYOU YU TIANRANQI DIZHI [OIL AND GAS GEOLOGY] in Chinese Vol 5, No 3, Sep 84 p 284

[Article by Wang Xu [3769 2485] and Zhang Zisu [1728 1311 2873]]

[Text] Since 1979 the Sichuan Petroleum Administration has regarded the acquisition of more reserves as its main goal and has been stressing the Carboniferous system of eastern Sichuan. It has earnestly strengthened geological prospecting and scientific research, enthusiastically advanced new technology and new techniques causing natural gas exploration and production to enter a new stage.

In order to realize major strategic breakthroughs, and open up a new situation in Sichuan's oil and gas exploration, the Sichuan Petroleum Administration, after attaining a productive gas flow in Chongqing's Xiangguosi structure Carboniferous system, concentrated its exploration efforts and carried out major exploration of the Carboniferous system of eastern Sichuan in a systematic step by step manner. Through five years of exploration and research, the distributed area, regional distribution and reservoir types of the Carboniferous system in eastern Sichuan were tentatively ascertained. A group of gas fields and gas-bearing structures were discovered, and a good gas flow was achieved in the Permian and Triassic. Recently, there were dolomite gas-bearing layers relating to bioherm discovered in the Permian Changxing formation of the Zhongxian Shibaozhai structure, this supplied new territory for further exploration. In a little more than 4 years the amount of newly found geological reserves in eastern Sichuan was 119 percent compared to the known reserves for the previous 23 years. The rate of success in exploration rose from 5 percent to 72 percent and, with a 20 percent increase in natural gas annual output, it has become the main base for natural gas production in all of Sichuan. There were also new discoveries in the secondary exploration of southern and southeast Sichuan with a group of new gas wells and new gas deposits being obtained. In ancient artesian gas fields the objective was to search for secondary gas deposits. Gas wells were drilled on the structure's periphery saddle, opening up a promising future for the old gas wells.

In the last several years the Sichuan Petroleum Administration has vigorously imported advanced technology and equipment, worked hard to replace the old

seismic technology and equipment, and strengthened seismological exploration. At the present time over 70 percent of the administration's seismic crews are equipped with digital seismographs, and some also equipped with infrared range finders. The seismic drilling rigs are now progressing toward becoming portable. The adoption of multiple overlying work methods in exploration has caused the collection of information in the field to rise by 210 percent. In the last 4 years seismic cross-sections have been done on a total of 23,817 kilometers, which is over one-fourth of the entire amount done over the last 30 years. The rate of qualified data was 99.7 percent and that of first class data was 90 percent. In order to improve the data processing and the quality of the seismic information, PDP/45 and Leisen 1704 computers were imported. Research has also been started on the morphology of steep structures. A 108,000-square-kilometer Permian Yanxin series structure map was constructed, which fairly accurately represented the structural features of the entire basin. Test results were obtained in eastern Sichuan using scientific research method stressed by the state--transverse wave method exploration--and provided a new way for joint longitudinal and transverse wave exploration, and the direct monitoring of gas in Sichuan's gas fields.

In the scientific research aspect of geology, the Administration has increased its scientific research capability, replenished some scientific research and analytical chemical examination equipments, and attained good achievements in scientific research. During the last 4 years 75 scientific research projects were completed, 8 of these received high quality science and technology prizes from the Ministry of Petroleum Industry and Sichuan Province. In the research of evaluating the Sichuan basin's carbonate sediment oil and gas resources, the scientific research personnel have begun addressing the crucial question of the amount of oil and gas reserve and the degree that exploration can ascertain it. They invoked and introduced the Wilson sedimentary facies model, the (Luoboding) theory and the Monte Carlo method in carrying out research on the relationship between the development of carbonate sedimentary facies over space and time with its reserve and mining conditions, and the evolution of its organic matter and eleven other special subjects. They established preliminary methods for evaluating oil and gas reserves, calculated the amount of oil and gas reserves in the basin and provided a scientific basis for drawing up a development plan for the Sichuan natural gas industry. In the research of the carbonate reservoir, the S&T personnel aimed at the inhomogeneous, low porosity, and low seepage characteristics of the deposit, and used electronic scanning, casting, optical spectrum and mass spectrograph analysis methods along with mathematical statistics, geomechanics and numerical simulation methods. On the basis of analytical research of the reservoir's lithological, physical, electric and oil and gas bearing properties, they carried out layer classification and analysis of the local structure's deformation characteristics. They researched the development causes of the structure's fissures, studied the formation mechanism of the lithological trap of the structural fissure, and predicted the growth and the energy of cracks in the oil producing layer structure. The research results have played a significant guidance role for the site selection in well drilling and helped to improve the success rate of the prospecting and the formation of the development plans.

Sichuan has rich oil and gas reserves, more than half of the discovered deposits have not yet been exploited and the future of prospecting is very promising. At this time the Petroleum Administration continues to concentrate on the general prospecting of the Carboniferous system in eastern Sichuan while searching for new gas reserves in already developed southern and southwestern Sichuan. In the meantime, the prospecting of the western and northwestern Sichuan and the Longmen Shan area is being actively pursued so that the reserve and production may be quadrupled in 1990.

9698
CSO: 4013/22

OIL AND GAS

PROSPECTS FOR OFFSHORE NATURAL GAS NEAR HAINAN ISLAND

Chengdu TIANRANQI GONGYE [NATURAL GAS INDUSTRY] in Chinese Vol 4, No 4, 28 Dec 84 pp 12-15

[Article by Zhao Liusheng [6392 2692 3932] and Wang Anqiao [3769 1344 0829]: "Prospects for Offshore Natural Gas Near Hainan Island"]

[Text] There are three offshore Cenozoic sedimentary basins near Hainan Island. To its north is the Beibuwan Basin, and to its west and south are the Yinggehai and Qiongdongnan Basins respectively (see Figure 1). Their combined total area is about 120,000 square kilometers of which an area of 60,000 square kilometers are favorable to gas-oil prospecting. They are all rift basins from the Tertiary Period and their petroleum geologic conditions are very advantageous. Since China launched cooperation with foreign countries to prospect and develop offshore gas and oil, large-scale physical prospecting and survey within the area has basically been completed. By 1983, dozens of wells have been drilled. More than half of them had obtained commercial gas currents, a number of gas-oil bearing structures have been discovered, and part of the gas-oil reserve has been controlled. In the light of prospecting results, the consensus in China and abroad is that the sea areas near Hainan Island are abundant in gas-oil resources, natural gas is even more attractive, scope of prospecting is broad, the future is promising and it is highly hopeful that it will be built into a maritime base for the production of natural gas.

Conditions of Sedimentary Basins

The three offshore sedimentary basins near Hainan Island have their own causes of formation. The Beibuwan Basin is primarily a graben-downwarped basin which subsided in the plate during the Tertiary Period. The Yinggehai Basin is an extension of the Honghe graben basin, which developed into a rift basin during the Tertiary Period. The Qiongdongnan Basin, like the neighboring Zhujiangkou Basin, is an epicontinental graben-downwarped basin formed from the expansion of small Nanhai oceanic basins during the Tertiary period. Despite the different causes in their formation, the three basins were all in a state of tension during the Tertiary Period and are tension-rupture basins favorable to gas and oil formation. As proven by large amounts of prospecting data in China and abroad, this type of basins generally have a high gas-oil content and abundant in gas-oil resources. For example, the

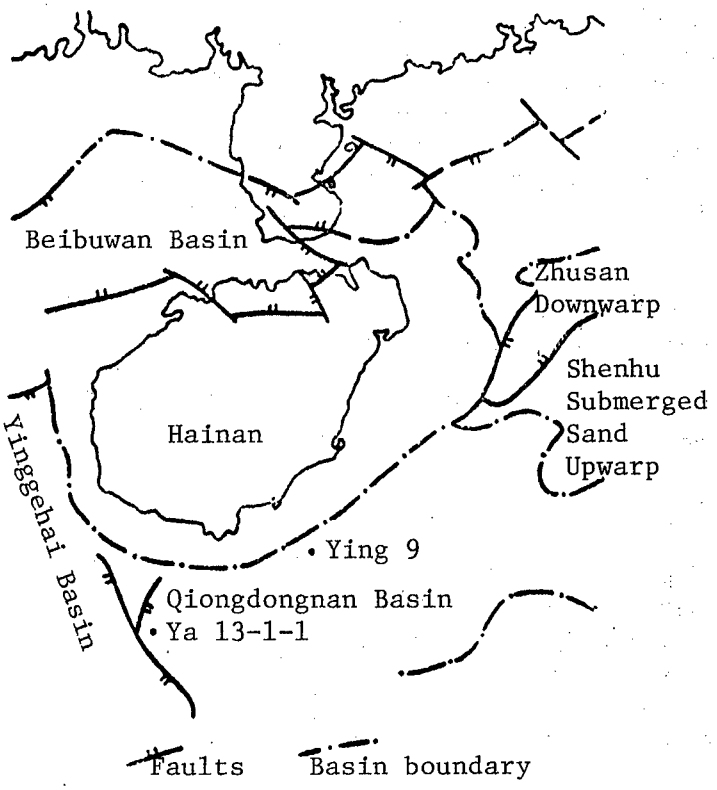


Figure 1. Locations of Offshore Basins Near Hainan Island

Tertiary tension basins developed in East China and in the Niger Delta of Africa have a verified geologic reserve that is equal to or greater than 100,000 metric tons per square kilometer, while the figure is over 300,000 metric tons for the Maracaibo Basin in Venezuela. One can see that the future of offshore prospecting near Hainan Island is very promising.

Sources of Natural Gas in the Sedimentary Basins

In order to explore the future of prospecting of offshore natural gas near Hainan Island, we must combine existing results of research and summarize our knowledge of natural gas sources and gas formation mechanism in sedimentary basins.

It is commonly believed that natural gas in sedimentary basins primarily comes from the thermal cracking of liquid hydrocarbons. After the formation of kerogen from oil source rock, it is accumulated in traps or becomes residue in the oil source rock. With the process of sedimentation, it becomes increasingly deep-seated, and as the geotemperature increases, the liquid hydrocarbons deeply buried in the high-temperature zone crack into condensed gas in the geotemperature zone of 150 to 180°C. When the temperature exceeds 180°C, all of it will crack into dry natural gas. According to simulation tests on crude oil pyrolytic gas formation, 1 cubic meter of crude oil will ultimately crack into about 100 square meters of natural gas. Another source of natural gas is direct formation of gaseous hydrocarbons

during the catabolic process of kerogen at the same time liquid hydrocarbons are formed. The amount of gaseous hydrocarbons formed is determined by the type of kerogen in the oil source rock. The article "Pyrolytic Simulation Test of Different Types of Kerogen in the Songliao Basin"[1] pointed out that in the thermal variation simulation test on pure kerogen (see Table 1), Type II kerogen forms the most hydrocarbon gases in the catabolic process, and the gaseous hydrocarbons are equivalent to 14.37 percent of the weight of kerogen.

Table 1. Quantities of Thermal Simulated Products of Different Types of Kerogen at the Daqing Oilfield

Gaseous Hydrocarbon Products (%)			Liquid Hydrocarbon Products (%)		
Type I	Type II	Type III	Type I	Type II	Type III
3.44	14.37	5.20	45.49	11.63	3.19

The second is Type I kerogen which forms 3.44 percent of gaseous hydrocarbons in the oil formation process, one-quarter of the volume of gas formed from Type II kerogen. Because the organic content of oil source rock containing Type I kerogen is higher than that of oil source rock containing Type II kerogen, and the organic carbon content is usually above 2 percent, for oil source rocks with the same volume the volume of gas formed is one-third to one-half of that of the latter. Oil source rock containing Type III kerogen forms the least volume of gas. In the simulation test on pyrolytic gas formation process 5.2 percent of the weight of kerogen formed gaseous hydrocarbons. Although the percentage of gas formation is higher than that of Type I kerogen, because the organic content of the oil source rock is low, a mere 0.5 percent, the hydrocarbonaceous gas formed from oil source rock with the same volume is much lower than Types I and II of kerogen (see Table 2).

Table 2. Unit Weight of Oil and Gas Formation Volumes of Different Types of Oil Source Rocks

Types of Oil Source bearing:	Organic Carbon Content (%)	Weight of Kerogen (kg/ton of oil source rock)	Weight of Kerogen (kg/ton of oil source rock)	Weight of Kerogen (kg/ton of oil source rock)
Type I Casein Radicals	2.5	25	11.37	0.86
Type II Casein Radicals	1.8	18	2.09	2.59
Type III Casein Radicals	0.5	5	0.16	0.26

In Table 2, the output of gaseous hydrocarbons by Types II and III kerogen is larger than the output of liquid hydrocarbons, but that experiment was carried out under the conditions of high temperature (500°C) and low pressure (sealed glass vacuum) so that gas output tended to be high. Under normal geologic

conditions for oil formation, the pressure of the earth crust is more than 100 to several hundred atmospheric pressures and the geotemperature is merely around 60 to 150°C, and the actual volume of gas formed will be several times smaller. Therefore, the various types of kerogen should mainly produce liquid hydrocarbons. Consequently, large amounts of the gas sources of sedimentary basins should primarily be thermal cracking of liquid hydrocarbons. This requires a sufficiently large amount of high-quality oil source rock deeply-seated in the high-temperature zone of sedimentary basins. Practice in prospecting of gas-oil bearing continental basins in China has proved that all areas where the oil source rock is deeply buried are correspondingly rich in natural gas high in the gas-oil ratio of crude oil, for example, Liaohe and Dagang oilfields. The gas-oil ratio of the Liaohe Oilfield is generally between 50 to 200 cubic meters per cubic meter. Although the types of kerogen are good in the Shengli and Nanyang oilfields, their organic content is high and their crude oil reserves are abundant, the oil source strata mostly lie outside the high-temperature strata and sections so that the reserve of natural gas and gas-oil ratio are both low and the gas-oil ratio is usually between 20 and 50 cubic meters per cubic meter.

Future of Offshore Natural Gas Near Hainan Island

With the exception of the Beibuwan Basin, all the oil source rocks of offshore sedimentary basins near Hainan Island have advantageous conditions for gas formation such as being thick, extensively distributed, abundancy in organic substance, deeply seated and having a high geotemperature gradient.

These basins were sag lake basins--bay sedimentation in the early Tertiary Period with a sedimentation as thick as over 3,000 meters (see Figure 2). Between the Eocene and Oligocene epochs, the climate of the sea area in the Nan Hai was warm and damp, biological growth was luxuriant and lower marine life developed, forming a set of oil source rock primarily containing Type II kerogen. It is estimated that the maximum thickness of its effective source oil rock was between 1,500 and 2,000 meters. Regional sedimentation took place in the basins during the Neogene period. Other than the sedimentation of large and thick Upper Tertiary marine facies in regions outside the Beibuwan which caused the Lower Tertiary oil source rocks in the deep sag areas to be seated in depths of 7,000 to 8,000 meters, the greatest depth was around 10,000 meters (see Figure 3). If we calculate on the basis of a geotemperature gradient of 3.2°C per 100 meters, its geotemperature would be as high as 250°C or more and the liquid hydrocarbons within must have been fully cracked into natural gas. Undoubtedly, this set of source oil rock series is the primary gas source rock of the Yinggehai and Qiongdongnan Basins. In the early Upper Tertiary System, the Sanya Formation (or Zhujiang Formation) and the Meishan Formation (or Hanjiang Formation) were deposited. These covered most of the area of the Yinggehai and Qiongdongnan Basins. This set of argillaceous rock is also an important set of gas source rock. Although the content of its organic substance is low (organic carbon is around 0.5 percent) and the type of kerogen is poor (primarily Type III) (see Figure 4), its effective oil source rock is thick, as much as 500 to 2,500 meters. At the same time, the type of kerogen in the deeply sagged areas may improve. It lies in the geotemperature zone of 150 to 250°C so

that the oil source rock has entered the stage of transformation from liquid to gaseous hydrocarbons. The volume of this set of oil source rock is enormous. Compared to the Upper Tertiary gas-oil bearing basins elsewhere in China, the conditions for oil and gas formation are even better (see Figure 5).

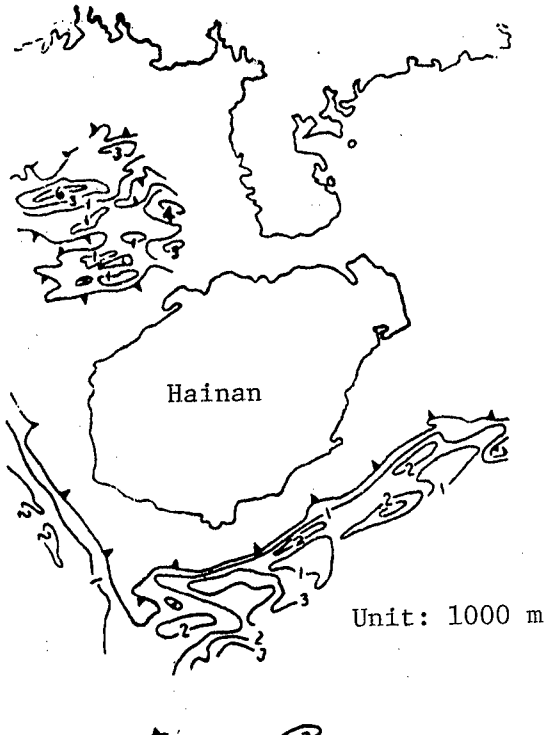


Figure 2. Isopach Map of Lower Tertiary System

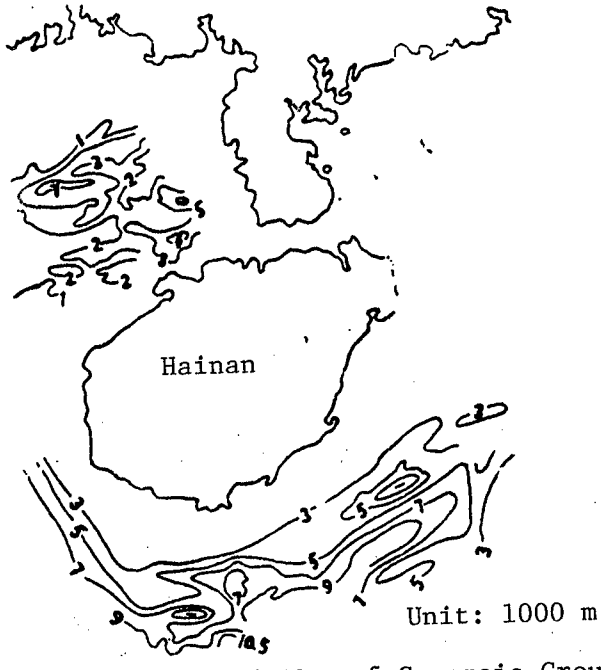


Figure 3. Isopach Map of Cenozoic Group

As the reservoirs of the Yinggehai and Qiongdongnan Basins develop, the shallow-coastal energy-rich sandstone, reef limestone as well as the large-scale turbidity sandstone of the Oligocene Lingshui Formation (or Zhuhai Formation) and Middle Miocene Meishan Formation (or Hanjiang Formation) will be the principal gas-bearing bed formation. The physical character of the sandstone of the Meishan Formation is particularly good, its mono-layer is thick and it is a reservoir with the greatest potential. Granite and metamorphic rock formations are widely distributed within the basins, and under the advantageous condition of being adjacent to or having direct contact with the Tertiary oil source rock, they may become prospective reservoirs. Instances of discovery of granite, metamorphic rock and buried hills facturing gas-oil reservoirs in gas-oil bearing basins in East China are common occurrences but are unresolved.

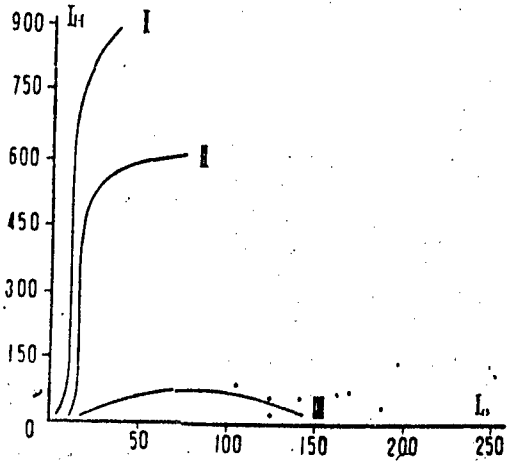


Figure 4. Typologic Map of Upper Tertiary Ganlaogen of the Qiongdongnan Basin

Good cap rocks and later conditions of preservation are even more important factors in the formation of natural gas fields. The argillaceous rocks of the Lower Miocene Sanya Formation, Upper Miocene Huangli Formation and Pliocene Yinggehai Formation of the Yingehai and Qiongdongnan Basins are developed. Their mon-layer is thick in, widely distributed and is ideally coordinated with the reservoirs. Local Neogene tectonization was peaceful and the upper strata of the Upper Tertiary system have no obvious signs of rupture thereby forming ideal regional cap rocks.

Traps are developed within the area. Their types are many and the total number of traps exceeds 100. The types of traps include bedrock draping anticlinorium, drag turnover anticline, fault compressed anticline, and those which are fault-related include semi-anticline, fault nose and fault block. Buried hill traps are widely distributed. The bioherm and mud mounds strata as well as lithologic traps in the waters of the Yinggehai are also quite developed. These many types of traps are undoubtedly favorable grounds for the enrichment of oil and gas.

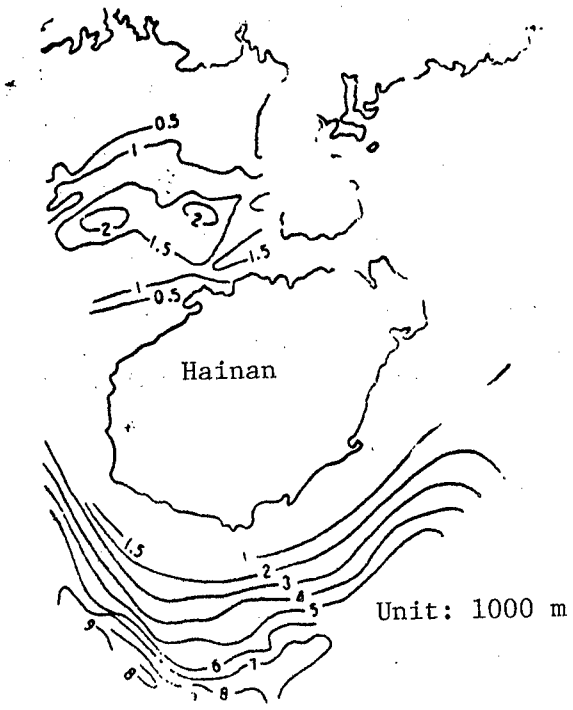


Figure 5. Isopach Map of Upper Tertiary System

In the light of the study on thermal evolution of oil source rock, large-scale gas formation of Upper and Lower Tertiary oil source rocks in the deep sags of the area took place roughly in the Middle and Upper Midocene, while most of the traps within the basins were formed before the formation of gas and were mostly distributed in the oil source rock formations or closely bordering oil source sags. At the same time, the lower portions of the Lower and Upper Tertiary systems are frequently accompanied by numerous large and small faults, forming good channels for the transference of oil and gas. The above factors in the excellent time-space coordination between traps and conditions of source rocks, reservoir rocks, cap rocks, transference, accumulation and preservation. Over half of the traps within the basins are in geotemperatures of 150°C or above, which are effective depths for the formation of gas. Not only can they accumulate natural gas directly provided by oil source rocks but the liquid hydrocarbons already accumulated in geologic times will constantly crack into natural gas and form rich natural gas accumulations.

After drilling in the YA 13-1 draping anticlinorium in the Qiongdongnan Basin, energy-rich coastal basal sandstone fabric of the Meishan Formation was encountered in depths of 3,573 to 3,692 meters, with a tested daily output of more than 1,200,000 cubic meters of natural gas as well as a small quantity of crude oil. The oil and gas of that structure primarily comes from the Lower Tertiary and Lower Miocene oil source rocks of the lower plate of the Xiling Fault, and secondarily from the Miocene within the scope of the structure. The discovery of that gas field fully demonstrates the promising future of the natural gas resources in the Yinggehai and Qiongdongnan Basins.

The Petrogeologic conditions of the Beibuwan Basin suit the formation of hydrocarbons primarily of crude oil, but because of the depth of Lower Tertiary oil source rocks in deep sags, they result in high gas-oil ratios in the Beibuwan oil fields, which is usually 112 to 195 cubic meters per cubic meter and as high as 1,351 cubic meters per cubic meter and an annual output of 1,000,000 metric tons of crude oil, the annual output of associated gas can reach 150,000,000 cubic meters, which is a considerable figure and should arouse sufficient attention.

Conclusion

Currently, two cooperative offshore prospecting and exploitation areas of Beibuwan and Yinggehai near Hainan Island have been opened up by China in cooperation with foreign countries. In China's first round of bids, three cooperative area-blocks have been signed. In the future there will be multiple rounds of bidding. By the early 1990's there will be a great international battle for offshore oil and gas prospecting and exploitation near Hainan Island. It is estimated that by the end of the 1980's exploitation will begin for a number of gas and oil fields, and by the early 1990's (or somewhat later) the sea areas around Hainan Island will become a major offshore gas producing zone in China.

This article was written with the assistance of chief engineer Meng Ersheng [1322 1422 4141] and was entirely checked by senior geologist Wang Shanshu [3769 0810 2579], both of whom the authors wish to thank.

FOOTNOTE

1. The authors of this article include Xu Zhentai [1776 2182 3141], Zhou Ping [0719 1627], Wu Yusheng [0702 3768 3932] and Zuo Shunlin [1563 7311 2651] of the Daqing Petroleum Administration; published 1982.

9586
CSO: 4013/83

OIL AND GAS

BRIEFS

HENAN CRUDE OUTPUT--The Zhongyuan Oilfield produced some 1,168,000 tons of crude oil in the first quarter, which was 26 percent more than in the same period last year. Its average daily output was some 2,400 tons more than that in the fourth quarter of last year. The oilfield produced 4 million tons of crude oil last year. [Summary] [Zhengzhou Henan Provincial Service in Mandarin 1030 GMT 8 Apr 85 HK]

COMPUTER LINKS PRODUCTION COMPONENTS--Daqing, 11 March (XINHUA)--Production at Daqing, China's leading oilfield, is now being handled by a remote computer network, the first of its kind in China, according to oil field officials. The remote computer network links multi-access microcomputers in the field's six major oil production departments. It collects data from more than 10,000 wells. Computers were introduced at Daqing oilfield in recent years but have been operated as single units until the network was set up. The work was done over the last two years by the Daqing oil field administration in cooperation with the University of Zhejiang. [Text] [Beijing XINHUA in English 0803 GMT 11 Mar 85]

U.S. COMPANIES MAKE STRIKE--In Contract Zone 1511 in the South China sea the U.S. Phillips Petroleum International Asia Company and Petcen Orient Company recently drilled a test well from which oil is now flowing. This well is 210 kilometers to the southeast of Guangzhou at a depth of 96 meters. The daily output is estimated to be 1,087 cubic meters with a specific gravity range of 0.8984 to 0.8299. The contract signed by the U.S. Phillips Petroleum International Asia Company and Pecten Orient Company and the China National Offshore Oil Corporation for cooperation in prospecting and exploitation became effective in January 1984. In the prospecting stage, the two companies are each responsible for 50 percent of the prospecting expenses in the contract zone. Phillips Petroleum International Asia Company is the operator in the contract zone. The operator has now begun to drill a second test well. [Text] [Guangzhou Guangdong Provincial Service in Mandarin 0400 GMT 12 Apr 85]

FIRST QUARTER '85 OUTPUT--In the first quarter of 1985, the Shengli oilfield in Shandong Province produced 6.58 million tons of crude oil, an increase of 1.57 million tons over the corresponding periof of 1984. Well drilling footage reached 970,000 meters, an increase of 570,000 meters over the corresponding period of 1984. [Summary] [Jinan Shandong Provincial Service in Mandarin 2300 GMT 1 Apr 85 SK]

JILIN TO DEVELOP NEWLY DISCOVERED FIELDS--Beginning in 1985, the provincial Oil Field Administration Bureau will develop, in a planned manner, the newly discovered oil fields in Qiannan and Zhenlai Counties in northwest Jilin, with the approval of the State Council. The Qianana oil field is located in the eastern part of Qianan County. The acreage of the oil pocket in the Gaotaizi oil well reaches about 40 square km and its oil deposits exceed 33 million tons. This oil field is beside the highway between Siping and Baicheng cities and is surrounded with plains or grassland that provides favorable conditions for developing the field. The Yingtaizi oil field is located in the northeast part of Zhenlai County, on the east bank of the Nenjiang River. The acreage of its oil pocket reaches about 50 square km, and its oil deposits are set at 30 million tons. [Text] [Changchun JILIN RIBAO in Chinese 29 Mar 85 p 1 SK]

DAQING INCREASES GAS PRODUCTION--Beijing 7 May (XINHUA)--Daqing oilfield, the largest in China, has produced 248,000 tons of light hydrocarbons, a major raw material for the chemical industry, over the past 3 years, PEOPLE'S DAILY reported today. Last year's production accounted for more than half the total, and the product is now Daqing's third largest after crude oil and natural gas, the paper said. In all, the oilfield in Heilongjiang Province has earned more than 90 million yuan from light hydrocarbons--a light oil condensed from natural gas. Work began in 1979 on installations for recovering the by-product, which was previously discharged or flared. Three years ago, Daqing built a light hydrocarbon separation plant with an annual capacity of 130,000 tons in cooperation with a local chemical plant. The plant has since earned 16 million U.S. dollars (46 million yuan) from exports of nearly 63,000 tons of naphtha made from the by-product. [Text] [Beijing XINHUA in English 0723 GMT 7 May 85]

CSO: 4010/137

NUCLEAR POWER

LI PENG ON 'PROPER' DEVELOPMENT OF NUCLEAR POWER

HK080444 Beijing GUANGMING RIBAO in Chinese 30 Apr 85 p 1

[Article By Li Peng [2621 2590]: "China Should Properly Develop Nuclear Power"]

[Text] At present, many countries in the world have nuclear power plants. According to statistics, there are a total of more than 500 [of these] including those that have been completed and those that are under construction in the world, with a total capacity of some 400 million kilowatts. By the end of this century, nuclear power will account for more than 20 percent of the world's output of electricity. Facts show that the construction of nuclear power plants is an important aspect of the peaceful utilization of nuclear energy, and is also an important measure to meet the increasing demand for energy. Nuclear power is a safe, clean, and advanced energy source, and nuclear generation of electricity will cause much less environmental pollution than thermal power generation.

Our country has rich coal and waterpower resources. So, to meet the demand for electricity in our country, we should mainly rely on thermal power generation and hydropower generation. However, it is also necessary to adopt the policy of developing nuclear power in a proper manner. There are three reasons for this: first, China has relatively rich resources of uranium, which provide a material foundation developing nuclear power; second, China has achieved well-known results in the study and manufacture of nuclear weapons, has established a rather comprehensive system in the nuclear industry, and has trained a competent contingent of technical personnel, which provides the technical conditions for developing nuclear power; and third, China has the need for developing nuclear power, especially in the economically developed coastal region where energy sources are in great demand. China is taking a belated step in building nuclear power plants and is trying to catch up with other countries as quickly as possible. However, in light of the economic reality in our country, we should not build too many plants at once. Our preliminary plan is to build three or four large and medium-sized nuclear power plants around 1990 and possibly achieve a total capacity of 10 million kilowatts before the end of this century.

In order to learn the technology for building and operating large nuclear power plants we plan to purchase from abroad a batch of equipment for large nuclear power plants in the form of economic and technical cooperation. China is now pursuing a policy of opening up to the outside world. It recently joined the international atomic energy agency, and has signed agreements on the peaceful use of nuclear energy with a number of countries. All of these provide the favorable conditions for cooperation with other countries in developing nuclear energy. At present, we are negotiating with enterprises from France, West Germany, and other countries in this regard. We will, after comparing their products, purchase the best equipment from among them in building the first group of nuclear power plants in our country.

As we all know, China is a developing country, and is also a big country. In carrying out our modernization program, we are unswervingly implementing the policy of opening up to the outside world, but our technical and economic cooperation with foreign countries must be conducted on the principle of independence, equality, and mutual benefit. In developing nuclear power, we cannot depend on imported equipment for a long period. While importing equipment from abroad, we must also enter into cooperative-production arrangements with foreign manufacturers and introduce into our country the technology for building the equipment so as to gradually increase the proportion of domestically made nuclear power equipment. For this reason, when we buy foreign equipment, an important criterion for selecting suppliers should be whether technology will be transferred to us along with the equipment. The Daya Wan nuclear power plant in Guangdong, a project to be operated as a China-foreign cooperative enterprise, will be the first large nuclear power plant in our country. A joint corporation has been established, and the initial construction work has already begun. In Ginshan, Zhejiang, a 300,000-kilowatt medium-sized nuclear power plant project has begun by relying mainly on our own efforts. These projects will have a positive effect on boosting our capability of self-reliance and on assimilating and mastering foreign technology of large nuclear power plants.

The construction of nuclear power plants involves complicated and comprehensive systems engineering, which requires, in particular, strict safety and quality assurance. To ensure safety in building and operating nuclear power plants, we have established a state nuclear energy safety bureau to assume the responsibility for exercising strict supervision of safety in the peaceful exploitation of nuclear energy.

I believe that with the joint efforts made by all parties concerned in our country, we will certainly succeed in building the first nuclear power plants in our country within a relatively short time and achieving the ability to conduct nuclear power construction on a considerable scale and to manufacture nuclear power equipment on an advanced technological level within this century. All these efforts will contribute to energy construction in our country.

CSO: 4013/132

NUCLEAR POWER

SYMPOSIUM ON NUCLEAR POWER PLANT SOLID WASTE DISPOSAL HELD

Beijing DIANLI JISHU [ELECTRIC POWER] in Chinese No 3, 5 Mar 85 p 79

[Text] The Bureau of Nuclear Power and the Office of Environmental Protection of the Ministry of Water Resources and Electric Power recently sponsored a symposium on nuclear power plant solid waste disposal in Jiaojiang City, Zhejiang Province. The symposium was attended by 53 delegates representing 38 different organizations from the Ministry of Water Resources and Electric Power, the Ministry of Nuclear Industry, the Ministry of Urban and Rural Construction and Environmental Protection, the Ministry of Geology and Minerals, the Academy of Sciences and its branch offices, Qinghua University, the Zhejiang Provincial offices of geology, earthquake, and environmental protection, the Taizhou Region, Jiaojiang City, and Sanmen County.

At the symposium, 15 delegates presented papers that covered the following areas: policies on nuclear power plant solid waste disposal, experiences and lessons learned from foreign waste disposal efforts, technologies and economic analysis of waste disposal, and studies on implementation of waste disposal plans. Representatives at the symposium participated in many serious discussions on the above topics.

It was the general opinion that since the period of safe disposal of radioactive solid waste is approximately 300 years or more, it will have a significant impact on human health and on the environment. It will also have a direct effect on the rate of development and safe operation of nuclear power plants. Furthermore, because of its far-reaching effects, strong political implications, high cost, long cycle and technological difficulties, it must be given sufficient attention during the initial phase of nuclear power development. Other countries have accumulated over 30 years of experience in waste disposal; we must carefully review the lessons learned from their experience in order to develop our management and research activities accordingly; we must also recognize the importance of carrying out parallel and coordinated efforts in developing nuclear power and waste management and disposal. Due to the lack of a national disposal plan, several of the nuclear power plants are currently planning to use temporary storage facilities. As the construction of some nuclear power plants is about to begin, it is essential that we do not delay any further in establishing a disposal policy in order to reach a satisfactory solution to this problem.

In recent years, many organizations in this country have initiated research programs in this area; the representatives believe that to avoid duplication of efforts, we must have a unified plan which will allow each organization to contribute its strength and ensure the overall work to proceed in a coordinated manner.

In an attempt to ensure continued progress in nuclear power development and that solid advances be made in nuclear power plant waste disposal, the representatives offered the following suggestions:

1. The disposal of radioactive solid waste is an important part of nuclear power development, and should be included as part of the national plan. The related research work and the construction of waste disposal sites should be listed as national planning issues and should be given sufficient attention during the initial phase. It was also suggested that the Ministry of Urban and Rural Construction and Environmental Protection assume the lead role and delegate responsibilities of organization and implementation to the individual departments.

2. In order to coordinate the development of solid waste disposal technologies with actual implementation, the Ministry of Urban and Rural Construction and Environmental Protection should establish China's policy on radioactive solid waste disposal and the necessary standards and regulations as soon as possible.

3. Under the leadership of the Ministry of Urban and Rural Construction and Environmental Protection, the electric power and nuclear industries, the departments of geology, transportation, and environmental protection, and the higher institutions and research organizations should participate in research on waste disposal which includes: establishing standards, regulations, disposal policies, and plans; engineering design, safety evaluation, economic analysis, and related basic research.

4. Based on the experience of other countries and the rate of development and layout of China's nuclear power plants, we should adopt a regional approach to waste disposal; however, this suggestion should be further analyzed and verified.

5. The efforts to promote science and technology should be intensified.

3012
CSO: 4013/122

NUCLEAR POWER

BRIEFS

NUCLEAR ENERGY INDUSTRY SHIFTING--At the 1985 Spring Trade Fair in Guangzhou, a responsible person of the China Atomic Energy Industrial Company told reporters that the Chinese nuclear energy industry is shifting from military use to civilian use. This means that civilian production will account for 80 percent of the industry in the future as compared with 80 percent for war production in the past. The responsible person noted that China's civilian nuclear energy industrial products are not only popular on the domestic market but have also made inroads into the world market. For instance, Chinese exports of metallic calcium [Jin shu gai], a major raw material for smelteries extracted from uranium ore, have grown to one-quarter of the world's total exports over the past 3 decades. The 47 civilian products of the China Atomic Energy Industrial Company were the center of attention at the 1985 trade fair. More than 70 groups of businessmen from Western Europe, the United States, Japan, Hong Kong, and Macao attended the fair for business negotiations. [Text] [Beijing in Mandarin to Taiwan 1500 GMT 5 May 85]

CSO: 4013/132

SUPPLEMENTAL SOURCES

ALTERNATIVE ENERGY RESOURCES VITAL TO RURAL DEVELOPMENT

OW260836 Beijing XINHUA in English 0758 GMT 26 May 85

[Text] Beijing, 26 May (XINHUA)--Redoubled efforts to develop all forms of energy are helping China meet the needs of rapidly growing agricultural production and the booming rural industries.

According to Deng Keyun, deputy secretary-general of the China Energy Research Society, more than 16,000 small coal mines have been opened in 27 provinces over the past few years.

These mines have introduced flexible production methods to retrieve shallow coal reserves and coal left in abandoned mines.

Small coal mines built by peasants have increased their output at an average annual rate of more than 13 percent, from 110 million tons in 1980 to 160 million tons in 1983 and a bigger increase is expected this year.

In addition, peasants have pooled their resources to build small hydroelectric power stations, with a generating capacity of several kW to several hundred kW each. Many places now use local electric power to process farm and sideline produce.

But the supply of commercial energy to the rural areas still falls far short of the demand created by the rapid development of the rural economy, Deng says in an article in the English-language weekly BEIJING REVIEW.

It is impossible for the state to satisfy the needs of the vast rural areas with a population of 800 million, Deng says, so China is encouraging each area to develop local energy resources according to its own conditions and encouraging more efficient, practical use of energy.

In the world today, about 1,500 million people still burn firewood for cooking and heating. Half of them are Chinese peasants.

The firewood and plant stalks burnt by Chinese peasants every year equal 220 million tons of standard coal. But owing to the low heat efficiency of the traditional rural firewood stoves (only 10 percent), the heat obtained actually equals that of only 23 million tons of standard coal burnt in a modern furnace.

He says that the rural areas need at least 20 percent more coal than what is currently available.

To solve these problems, Deng says, it is necessary to stress reforestation and efficient use of firewood as firewood will continue to be the peasants' main daily energy source in the next 20 to 30 years.

Now a kind of woodburning stove with 25 percent heat efficiency is being popularized in the rural areas. More than 18 million peasant families are using these economical stoves, saving 4.5 million tons of standard coal.

The government plans to help 100 million peasant households build this type of stove before 1990, which will save vegetation equivalent of 33 million tons of standard coal a year.

Another easily available source of energy is biogas. China has more than 3.76 million household biogas generating pits, which can produce 1,000 million cubic meters of biogas a year, equivalent to 650,000 tons of standard coal.

The government plans to build another 5 million before 1990, with the peasants contributing the funds and the state providing technical assistance.

In recent years, good results have also been achieved in developing other sources of energy, including solar energy, Deng says.

Since 1980, Xiaolong town on the loess plateau in Gansu Province has set up more than 10,000 solar cooking stoves, which can be used 200 days a year.

On the coast of Zhejiang Province, three tidal power generating stations have been built. Geothermal energy resources are being tapped in Tibet, Fujian, Liaoning, Hubei, Jaingxi, and other places.

The government formed a leading group headed by vice-premier Li Peng last year to guide and coordinate the planning and research work related to rural energy development.

In addition, more than 70 institutes of higher learning and research are working to popularize rural energy advances.

CSO: 4010/147

SUPPLEMENTAL SOURCES

SYMPOSIUM EXPLORES USE OF HYDROGEN AS MOTOR VEHICLE FUEL

OW071403 Beijing XINHUA in English 1257 GMT 7 May 85

[Text] Beijing, 7 May (XINHUA)--Hydrogen is the best energy that mankind can use, according to an international symposium on hydrogen systems that opened here today.

The symposium, sponsored by the China Association for Science and Technology and the International Association for Hydrogen Energy, is being attended by 120 specialists from China and 11 other countries including the United States, Federal Germany, Japan, and Canada.

Zhu Yajie, president of the China Energy Research Society, said that it is not only possible but necessary for China to switch to hydrogen energy.

Experiments in Shanghai and other cities have shown that mixing 5 percent hydrogen in gasoline will cut consumption by 25 percent, and reduce the harmful ingredients in the exhaust gases.

A large quantity of hydrogen, a by-product of electrolysis in salt and fertilizer plants and breweries, is being wasted.

China has developed titanium iron hydrogen storage material, so that hydrogen energy may be safely stored and carried in automobiles, Zhu said.

Chinese specialists suggest that to reduce air pollution, Beijing should lead the way in the use of gasoline and hydrogen mixture in public buses.

The view was shared by T.N. Veziroglu, president of the International Association for Hydrogen Energy, who thought it possible to put hydrogen energy to wide use in the coming years. He predicted that by the end of the 1980s, hydrogen energy will be as cheap as gasoline.

Specialists said that hydrogen is the cleanest energy form, and that it is easy to store and transport compared with solar and nuclear energy.

They also pointed out that as fuel, oil, and coal have seriously polluted the environment and, as limited resources, they should be made better use of such as in making synthetic fiber and fertilizer.

CONSERVATION

BRIEFS

ENERGY CONSERVATION PROJECTS--Shanghai, 31 March (XINHUA)--China's leading industrial city of Shanghai has decided to spend more than 60 million yuan this year transforming the energy-consuming equipment, according to municipal authorities. When completed, the program will save energy equivalent to 200,000 tons of standard coal annually, which will help the city fulfill the planned economic growth of eight percent over last year. The energy conservation program includes updating 320 big industrial boilers and replacing 30 old models, revamping 2,600 blowers, 3,700 water pumps, some industrial furnaces and kilns and heating systems. Shanghai's effort is a part of China's energy-saving drive. Chinese enterprises saved energy equivalent to 30 million tons of standard coal in 1984, which explains China's 13.6 percent growth of industrial output value when energy production rose only 7.4 percent. [Text] [Beijing XINHUA in English 1143 GMT 31 Mar 85]

CSO: 4010/121

CHINA TO BUILD FOUR NUCLEAR POWER PLANTS IN 5 YEARS

HK181136 Hong Kong HSIN WAN PAO in Chinese 18 Apr 85 p 4

["Special dispatch": "China Buys Nuclear Plant Equipment To Build Four Nuclear Power Plants in 5 Years"]

[Text] Beijing, 18 Apr (HSIN WAN PAO)--Li Peng, vice premier of the State Council, recently declared that China was going to buy some nuclear power equipment from foreign countries in the form of economic and technological cooperation so as to meet China's short-term demand for energy.

"Special Issue on the Nuclear Industry" [HE GONG YE ZHUANG HAO 2702 1562 2814 1413 5714], a large-sized picture album comprehensively covering China's nuclear technology development, is to be published soon. On invitation, Li Peng has written an article for the book to elaborate China's policy on nuclear technology.

Li Peng held that China must do its best to catch up with the world in development of nuclear power technology as quickly as possible, since China started its efforts in the field later than others. However, given the actual economic conditions in China, the country cannot start many projects all at once. According to a tentative plan, four large and medium nuclear power plants are to be built around 1990 and the nuclear power installed capacity is to reach 10 million kilowatts by the end of the century.

In mentioning the four nuclear power plants, Li Peng probably meant the Zhejiang Qinshan nuclear power plant and the Guangdong nuclear power plant, which are currently under construction, and the Liaoning nuclear power plant and the Jiangsu nuclear power plant, which are going to be built. It was said that the provinces of Jiangxi, Sichuan, and Shandong are most likely to build nuclear power plants.

Li Peng is a member of the State Council in charge of energy affairs and the director of the nuclear power leading group of the State Council. He also disclosed that China was now negotiating with the governments or enterprises of France, West Germany, Japan, and the United States and was going to buy elected equipment after comparison.

He pointed out: While importing foreign equipment, China will introduce manufacturing technology through cooperation in production to increase the variety of Chinese-made nuclear power equipment. Therefore, when selecting and purchasing foreign equipment, China will review the suppliers' willingness to export technology as an important factor.

END

CSO: 5100/4133